



# The American Journal of Surgery

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NEW SERIES, VOLUME X

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No. 1

## OF PHYSICIANS AND SURGEONS AND THEIR MUTUAL RELATIONS\*

URBAN MAES, M.D.

NEW ORLEANS, LA.

LAST winter, within ten days, I operated on 3 desperately ill patients. The first was a man with acute appendicitis who had been treated medically for two days. The second was a woman with obstructive malignancy of the colon who had been treated for constipation and indigestion for three years. The third patient, also a woman, presented a necrotic bowel following intussusception and had been treated by colonic irrigations for a week. They all died, and they were all, naturally, charged against me as surgical deaths. I have no doubt that in each instance, had my course been different, the outcome might have been happier, but, and this is the crux of the situation, in each instance I saw the patient only after medical treatment had failed to effect a cure.

These are extreme instances, I grant you, or rather the sum of them is extreme; yet every practicing surgeon is confronted again and again with the same problem. A hundred years ago perhaps there might have been some excuse for it, for medicine and surgery had not yet fully emerged from the blight of the great medieval schism. You know how these two great branches of medical science, unified under Hippocrates, our common father, were separated from each other in the thirteenth century by the Papal Bull which forbade the monks, the physicians of the day, to participate in the shedding of blood,

and which left surgery a separate and inferior branch of medicine until, to quote Cushing, it climbed into some measure of professional and social esteem by way of the barberpole. Until very recent times the surgeon's lot was not an enviable one. He was a mechanic and nothing more. He did his cutting at the instigation and under the actual direction of the physician who had called him in, and often he was not even permitted to be present at the consultation which determined whether or not his services would be needed.

Of course he is no longer the stepchild of medicine. He is true son in his father's house. But at that, the old ideas persist, the middle wall of partition is not yet broken down, and medicine and surgery are still covertly if not overtly hostile to each other. Yet they are not separate branches of medicine. They are not substitutes for each other. Rather, each is the complement of the other, and except in the matter of actual therapeutics their paths should not diverge. Medicine may be an abstract art and surgery a concrete one, but their aims are and should be the same, and, as Royster shrewdly says, the business of the physician should be to cure the patient, not to parcel him out.

The surgeon very often does not have a fair deal in the matter of treatment, not to speak of diagnosis, and I do not make that statement because surgery happens to be my specialty. It cannot be denied

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that probably 90 per cent of all surgical conditions are seen first by the family doctor, the general practitioner, the internist, or whatever you may choose to call him, and that the surgeon is usually a consultant, and a late consultant at that. It is the medical man who sees and evaluates the inaugural symptoms of disease, and who, when medical treatment has failed, calls in the surgeon to do a purely mechanical job and, in a regrettable number of instances, to sign the death certificate. The surgeon, do not misunderstand me, is not free from blame. He hesitates and temporizes quite as often, proportionately, and quite as disastrously as his medical confrère. But his chances of error are fewer because in the majority of cases he is in only at the end, is in, often, literally only at the death.

Why the internist should dread surgery, if not the surgeon, it is hard to say, but it is an undeniable fact that he does. I am not now referring to that very small proportion of medical men who are wilfully dishonest, who falsify postoperative mortalities and multiply operative failures, who divert their patients from the surgery they often urgently need with the story of its risks and its poor results. These gentry exist, though fortunately for the credit of our profession they are few. But I have reference to the well-trained, scholarly, competent, honorable medical men who, in spite of their training and their experience, simply will not regard surgery as a branch of therapeutics, who persist in regarding it as a last resort, a method of treatment only slightly less dangerous than the disease itself, and therefore not to be considered seriously until death threatens or life becomes intolerable without it. That point of view clearly is responsible for many of the disasters and many of the failures of surgery. Of course there are some things which surgery cannot do; like old Sir Thomas Browne, "I am not only ashamed but heartily sorry that besides death there be diseases incurable" and I would

not have you think that mere cooperation between physician and surgeon will bring about a medical utopia in which there shall be no more death. But I would plead for a closer liaison between them, and particularly for an earlier liaison.

This is especially true in the matter of diagnosis. Some diseases are frankly medical, others are frankly surgical from the outset, but there still remains a very large proportion of diseases which are frankly neither, but which may be either or may be both, and which, for their care and cure, demand equally the resources and the skill of both medical man and surgeon. Surely the surgeon has as much right to share in the study of such patients as the medical man has. A sheaf of reports may save him effort, but nothing can take the place for him of personal bedside observation, particularly in conditions in which the findings change from day to day and hour to hour. In the matter of laboratory studies I do not think the surgeon has entangled himself quite as deeply as the medical man has, and for myself, I plead guilty of belonging to that old school, now rapidly disappearing, I fear, which believes that the sole purpose of the laboratory is "to increase the accuracy of a clinical opinion," the opinion being based, of course, upon clinical observation and clinical experience and not upon mere guesswork.

Another consideration is the matter of treatment prior to diagnosis. Later I shall take up this subject in reference to special diseases, just here I would simply point out that the treatment of symptoms instead of the treatment of the essential pathology which is responsible for them, while it is a regrettable necessity in a certain proportion of cases, a certain very small proportion, is, as a general thing, a procedure heartily to be condemned. In the first place, it is seldom of more than passing benefit; in the second place, it means the loss of valuable time; in the third place, it may do actual harm. There is both a science and an art of

medicine, and while it is the art of medicine which cures the patient, it is the science of medicine which makes the art possible.

It is difficult to conceive of any medical disease which may not present either an inherent or an intercurrent surgical factor, and in exactly the same way it is impossible to conceive of any surgical disease which may not present a medical factor. The chest cavity, for instance, was long considered a surgical *noli me tangere*, but consider the advances recently made in the treatment of chest conditions, advances which are in large part due to the investigations of the members of the American Association of Thoracic Surgeons and which disprove for the hundredth odd time Erichsen's remark of seventy-five years ago, "Surgery is at its zenith and no further advances in it are possible." Extrapleural thoracoplasty yields a fair measure of success in diseases formerly considered strictly medical. Graham has devised the operation of lobectomy, applicable to the occasional case of localized bronchiectasis. Claude Beck has recently suggested pericardiectomy for Pick's disease, and Trendelenburg's operation for pulmonary embolism has been simplified and given a wider application, notably by Prof. Nystrom of Sweden. Cutler has done brilliant cardiac surgery for mitral stenosis. Coffey and Browne have advised the treatment of angina pectoris by sympathectomy. Phrenico-exaeresis has been suggested for tuberculosis and similar lung conditions, and tuberculosis of the unilateral type is arrested in the majority of cases by putting the affected part at rest by artificial pneumothorax. Pneumonia is a distinctly medical disease, but once the crisis has occurred, if fever persists, then the surgeon had best be summoned promptly, for empyema is undoubtedly a complication and the sooner that fact is recognized and surgical intervention instituted, the shorter will be the morbidity and the less the mortality.

These chest conditions furnish a particularly good example of the point I have

been trying to make, for chest conditions are traditionally the domain of the medical man. Yet I am sure you will agree that every one of the diseases I have named could, in selected cases, be benefited by surgical intervention. On the other hand, the type of case for surgery, the time of intervention, and to some extent the degree, can best be decided upon by the internist. Auscultation and percussion of the chest cavity require a high degree of skill, and the surgeon lacks practice in them and is correspondingly inexpert. There should be no hasty resort to surgery, for the chest has a recognized ability to tolerate large accumulations and a recognized immunity to infection, but it is likewise a mistake to defer measures of relief until respiration is embarrassed and the heart is displaced. Surgery of the chest, by the way, furnishes a very excellent illustration of the need of surgery and medicine for each other. It was Murphy the surgeon who first thought of putting the affected lung at rest, but, as Cushing has pointed out, it was Jacobaeus the physician who conceived the intrathoracic separation of pleural adhesions and so completed the operation.

Diabetic surgery is another particularly shining example of the cooperation for which I am pleading. Formerly it carried a mortality which ranged, at least for some procedures, as high as 50 per cent; now, thanks to insulin, the diabetic, providing he is properly prepared, is almost as safe a surgical risk as his non-diabetic brother. He is liable to any surgical condition to which the rest of mankind is liable, and he is particularly liable to two special conditions, infections, and gangrene of the extremities. He has certain definite disabilities, especially a tendency to acidosis and coma, and these tendencies are exaggerated under the stress of his surgical condition. His diabetes increases his infection, his infection increases his diabetes, and insulin, his safeguard ordinarily, loses from 50 to 75 per cent of its effectiveness under the circumstances. His pathology

is fundamentally medical, yet his surgical complication is a tremendously important incident in it. As Joslin says, the patient who is treated first for his diabetes and second for his surgical condition is likely to have a very brief illness. He demands a dual control. His safety rests upon a pre-operative preparation and a postoperative care almost mathematical in their exactness, but not to be applied by a standard formula, for each case must be evaluated and treated individually. The surgeon has neither the time nor the training to apply this care. In this single instance his function is solely to give mechanical relief, and to exercise increased promptness and increased gentleness as he gives it, for the diabetic does not tolerate delay or trauma. Particularly in diabetic gangrene is promptness of treatment essential. Surgical intervention at an early stage may permit conservatism, whereas surgical intervention at a late stage, even if it is successful in the sense of preserving life, must always be radical. I emphasize this point particularly, for future usefulness is a very important consideration in these days when, as the result of insulin, the life expectancy of the diabetic has been so materially increased.

Although its treatment is chiefly surgical, osteomyelitis is a disease whose diagnosis, I have learned from a sad experience, is practically never made by the surgeon for the simple reason that he never has the opportunity of making it. Acute osteomyelitis in its initial stages is never seen in surgical wards. They are filled with chronic cases, usually cases with extensive bone destruction and often lessened constitutional resistance. The correct diagnosis is not made in 25 per cent of all early cases, temporizing medical measures are employed at the only time when conservative surgery would be of benefit, and finally the patient is handed over to the surgeon when nothing short of a mutilating operation could be expected to give results. This is a disease which is curable in nearly 100 per cent of

all early cases by the simple procedure of making an opening into the involved bone, a procedure which would do no harm, by the way, if the diagnosis of osteomyelitis should happen to be incorrect, and which would eliminate most of the mortality, the disability and the economic waste which now follow in its train.

The acute abdominal diseases furnish the best possible illustration of the bad results which are inherent in a lack of cooperation between the internist and the surgeon. All of them except acute cholecystitis and acute salpingitis, which are self-limiting diseases, are frankly surgical, and the mortality rates in them depend, above everything else, on the length of time which elapses between the onset and surgical intervention. Symptoms and pathology do not necessarily parallel each other exactly: pathology always exists for a longer or a shorter space of time before it manifests itself in symptoms, and unbelievably grave pathology often ensues in an unbelievably short time. But as a general rule it is true, and it has been proved by clinical experience and statistical studies, that the prognosis in acute abdominal diseases is dependent upon the length of time between onset and operation. If surgery could be done within twelve hours after the appearance of symptoms, the mortality would be almost negligible. What Lord Moynihan says of intestinal obstruction, that any mortality over 10 per cent is the mortality of delay, could be applied, with a change of figures to suit the special case, to every instance of acute abdominal disease.

Intestinal obstruction and acute appendicitis are responsible for the highest proportion of fatalities in abdominal disease, and they furnish it because of delay. Patients are treated ignorantly, not expectantly. They are given purgatives, too often by physicians, which increase the pathology present, and they are given opiates which mask the symptoms. Surgical intervention is delayed until the classic syndrome appears, with complete oblivion

of the fact that the initial signs of these two diseases, the initial clinical manifestations, differ radically from the classic syndrome, and that its appearance quite as often heralds the exitus as it clinches the diagnosis.

I am not an advocate of promiscuous surgery; I am a firm believer in accuracy of diagnosis; but I likewise contend that in acute abdominal conditions in which the pathology is doubtful, an exploratory incision is nothing more than the patient's right. Most of these diseases are surgical, and Whipple's advice to eliminate non-surgical conditions and then operate is life-saving advice. An exploratory incision does not kill, though many a patient dies because it is withheld, and it would profit both surgeon and internist to study their pathology in the living subject through an opening in the abdomen rather than at the most careful possible autopsy, when the investigation can no longer benefit that special patient.

The relationship between the two chief gastric diseases, ulcer and carcinoma, is admitted, though the exact proportion is still debated. It is granted, I think, that some 6 per cent of all supposed ulcers are primarily malignant, and the percentage which becomes malignant later is variously estimated at from 10 to 70 per cent, McCarthy of the Mayo Clinic being responsible for the latter figure. If we accept the fact of the relationship, regardless of the exact figures, we must accept as a corollary that surgical treatment of all ulcers which do not respond promptly to medical treatment is the only sane treatment. I am far from saying that all peptic ulcers should be treated surgically. I am entirely in favor of a fair trial of medical measures, though I would add that it is difficult to estimate the proportion of ulcers which are thus cured. For one thing, all ulcer diagnoses are not correct; even with the x-ray there is a very fair percentage of error, and without it a diagnosis is not worth the paper it is written on. For another, the cure of an

ulcer must not be confused with the relief of its symptoms, which latter, by natural remission, would occur with no treatment at all after a certain period of time. Last year, within a month, I operated on two medically cured cases of peptic ulcer. Both patients were almost exsanguinated, and both of them were correspondingly poor surgical risks. They both recovered, but I do not think their respective physicians were ever convinced, in spite of my eloquent exposition of the subject, that operation before the hemorrhages had occurred would have been better for the patients, not to mention my own peace of mind for several days postoperative, though I am equally sure that if the outcome had been otherwise the deaths would have been charged to surgery and its attendant risks.

As a matter of fact, the surgical mortality after gastroenterostomy, which is the preferred treatment for uncomplicated ulcers, is very small in elective operations done by competent surgeons, though it mounts appreciably in the presence of hemorrhage and perforation, both of which contingencies, it seems to me, are usually reflections on the quality of treatment which permitted them to come to pass. Moreover, Balfour's recent study shows that the life expectancy after operation for peptic ulcer is rather more than ten years longer than the average life expectancy for the same age. This being the case, it seems only reasonable that the patient be given the opportunity of deciding for himself whether he prefers to live his life hedged about by dietary restrictions, with the risk of hemorrhage and perforation always a possibility, and not always a remote one, or to take his chances with surgery, which is seldom as dreadful as it is pictured. One last word on this special subject: the Mayo Clinic is able to report the highest recorded percentage of cures for gastric malignancy, and the explanation is perfectly simple; their policy is to explore routinely for indigestion of undetermined origin which



does not yield promptly to treatment. For that reason they encounter the disease in its early and therefore in its operable and therefore in its curable stages.

Much the same argument holds for gall-bladder disease. Not all cases demand operation. The acute type never does, unless there is evidence of impending perforation, gangrene or rupture, all of which are late manifestations, all of which increase the surgical mortality appreciably, and all of which, again, are reflections on the type of professional attention which permitted the disease to reach such a pass. The type in which only the bile is infected and the wall is not involved, and in which there is an associated duodenitis, is not a recurrent condition and is not benefited by surgery, as I know from one regrettable personal experience. Nor does one attack of cholecystic disease usually serve as an indication for operation; there is little excuse for that sort of reckless surgery. But I would remind you that this is a disease which we now know begins early in youth, not late in adult life, as we had once supposed, and which is manifested then by indigestion and not by the characteristic syndrome we have long associated with its adult manifestations. Medical treatment is indicated over a limited period of time; if it does not effect prompt results, then there should be a prompt resort to operation, for repeated studies show that the cases of gall-bladder disease which are not benefited by surgery are the cases in which the disease can be traced back many years and in which there is marked associated pathology in the ducts, the liver and the pancreas. Surgery in such cases will arrest the further advance of the disease but it cannot work miracles, complete relief of the symptoms is not to be expected, and the failure should not be charged to the system of therapeutics but to the procrastination which permitted a practically irremediable condition to develop. The cooperation of the internist is often sorely needed in these late cases, to assist in preparing the poor risk for operation

and to train him afterward in the principles of rational living. My own experience is that no group of patients is harder to control in this regard, and the internist is far better equipped for the task than is the surgeon.

Thyroid disease is on the borderline of medical and surgical diseases. It may be stated categorically that simple colloid goiters and cystadenomata are never surgical unless their size demands mechanical correction, but that all toxic thyroids are surgical. Likewise it should be emphasized that the prevalent conception that the continued use of Lugol's solution will cure them is entirely erroneous. I have recently seen a patient with a toxic goiter who had been treated by this method for more than a year. He is coming to operation now, not in the least benefited, of course, with an impaired heart function and a lessened constitutional resistance, and with the usual beneficial effects from the preoperative administration of Lugol's solution not to be expected. The patient with a toxic thyroid needs the most careful possible treatment, but he is from the beginning a surgical and not a medical problem.

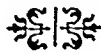
One other specific condition deserves at least passing notice, the disease we ordinarily term chronic appendicitis, though I hesitate to call it appendicitis, for it is usually something else. The recurrent type of appendiceal disease is, of course, strictly a surgical condition, but the vague syndrome characterized by right iliac pain and indigestion is definitely not, though it is frequently handled as if it were, and it materially increases his percentage of poor results for the surgeon who acts as if it were. It is preeminently a disease for the medical man to diagnose and treat, for everything from simple constipation to intercostal neuralgia must be differentiated from it. And if the surgeon finally in desperation attempts to cure it by surgery, my advice to him would be to have the medical man at his elbow during his performance, as well as during later office

consultations with the patient, for in only too many cases there will be reproaches to be divided.

Lack of time does not permit me to emphasize the important rôle which the medical man plays in the preparation of poor operative risks, the cardiac, the cardiorenal and the pulmonary patients, whose preliminary care is often prolonged and exacting, and for whom the time of operation should be set by the internist, not the surgeon. Likewise, I cannot emphasize the internist's rôle in the care of postoperative patients, particularly those with cardiac and pulmonary complications, though these latter are fortunately becoming rarer as the technic of anesthesia becomes more expert and the choice of anesthetics wider. As a matter of fact, it would be an ideal thing, though I am afraid a rather impractical one, for a medical and surgical alliance to be formed for the management of all surgical cases. As Royster puts it, the medical man is needed not only for postoperative patients who are doing poorly, but for patients who are doing well to keep them from doing poorly. That is a wise and rational view, for many a partially or wholly unsuccessful operation of my own I know could have been transformed into a successful one if the patient had only been

taught afterwards the principles of correct living.

I have not meant in this cursory paper to give you the idea that I am advocating that the medical man should undertake the functions of the surgeon or the surgeon the functions of the medical man. Nothing is further from my thoughts. Medicine is too complex, too manifold, to permit of that today, even if it were desirable. Nor have I intended to be ungracious in my strictures on the medical man. I naturally speak with a bias for the surgeon, but I freely admit that both are equally guilty of this unhappy division. My only point is that the hostility must be ended, that we are not fulfilling our duty to our patients as long as we permit it to exist. Dr. Harvey Cushing, in one of the most scholarly addresses ever delivered before the American College of Surgeons by any of its presidents, opened and closed his paper with a quotation from an old medieval physician, which I take the liberty of repeating to you: "No one can be a good physician who has no idea of surgical operations, and a surgeon is nothing if ignorant of medicine." That was his theme, as it has been mine. We are all physicians. Some of us practice medicine, some of us practice surgery. But in the fundamental things we are all physicians. And that, after all, is all that really matters.



# SURGERY OF THE SYMPATHETIC NERVOUS SYSTEM\*

## A REPORT OF FOURTEEN SYMPATHETIC GANGLIONECTOMIES

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FOR the past year there has been a steadily increasing interest in the sympathetic nervous system. A great deal is being written on the anatomy, the physiology, and the various functions of this very interesting portion of the nervous system. As our knowledge of its functions increases, we are impressed by the increasing possibilities of surgical intervention in diseases, the symptomatology of which is largely referable to its effect upon the sympathetic functions.

There are certain conditions in which the treatment by surgical attack upon the sympathetics is established on firm ground. Among these are Raynaud's disease, scleroderma, chosen cases of Buerger's disease, and megacolon. Recent reports also tend to place certain types of chronic arthritis in this established class.

We wish to report a series of 14 cases of patients operated upon last year. Among them are included many of these conditions but there are also included several operations for other conditions of a much more experimental nature. The results of some of these have been as striking, or even more so, than the results in some of the more commonly operated conditions. The scope of this paper will not include a review of the results of other workers, merely a report of our own work and the results thereof.

### BUERGER'S DISEASE WITH VASOSPASM

Unfortunately, only about 25 per cent of the patients we see having endarteritis obliterans or Buerger's disease, are suitable for operations on the sympathetics. The question of operability, we believe, depends upon the amount of associated vasospasm. To determine operability, it is necessary to do a skin temperature test to

determine the vascular index. This is done by taking the skin temperatures before and after intravenous injection of typhoid vaccine. The relation of the rise in skin temperature at the height of the reaction to the rise in mouth temperature determines the vascular index. It is, of course, necessary to make allowances for variation in room temperature. We hesitate to operate unless the index is at least two; in other words, unless there is twice as much rise in skin temperature as in mouth temperature in response to the intravenous injection of typhoid vaccine. The greater the index, of course, the more favorable are the chances for a good result.

Where the vessels are not palpable and gangrene has set in, it is folly to operate unless the vascular index shows a favorable response. It is our feeling that practically every case of endarteritis obliterans that gives a favorable index is one in which there is an associated vasospasm of the peripheral vessels. Those cases in which the trophic disturbances are not associated with vasospasm, in other words, where the condition is entirely due to the obliterating endarteritis, are rarely, if ever, benefited by sympathetic ganglionectomy.

In our series to date are included 3 cases of Buerger's disease with associated vasospasm, 2 of them in the upper extremities and one in the lower extremities. Following are the case reports.

CASE 1. S. B. aged twenty-seven, Russian Jewish descent. Occupation fur-cutter. Married three years, no children.

Onset early in 1927, with flushing and burning sensation in the left great toe, usually in the evening after being on his feet all day. Would have free intervals of several weeks, then trouble again for several days. This condition was present only in the winter time. In the

\* From the Neuro Surgical Clinic of Seattle, Washington. Read before the Southern Idaho Medical Society March 26, 1930.

fall of 1927, after being free all summer, the trouble recurred. He consulted several physicians in Chicago without obtaining relief. A small scab formed on the end of his great toe. This scab sloughed without any bad result. In January, 1928 he spent two weeks at the Mayo Clinic, where a tentative diagnosis of Buerger's disease was made. When, too, red blood cell counts of between eight and ten million were found, a diagnosis of polycythemia vera with a vasomotor disturbance in the nature of an erythromelalgia was finally made. He was treated with radium locally over the foot and phenyl hydrazine. After several months the condition in the foot was entirely relieved and he has had no trouble since except that he is apt to have pain in his left calf if he exercises too violently. Previous to his sojourn in Rochester, he had noted, at times, a vague tingling sensation in the fingers of his left hand. In February in Calgary, Alberta, where winter is quite severe, he had a sudden onset of sharp tingling pain in the fingers of his left hand. This continued for three weeks and then gradually disappeared but the hand and arm have never felt right since that time. From then until first seen by us he had occasional tingling pains in the left hand and arm, with aching and stiffness of the joints.

In July, 1929, following a slight injury, a yellowish area appeared on the tip of the index finger of his left hand. This area did not heal. Some pus was evacuated but still it did not heal. After three weeks a surgical debridement was done, but the same area recurred and refused to heal. At this time a blood count revealed six and one half million red cells in spite of the constant use of phenyl hydrazine. He then consulted a doctor of Seattle, who treated the finger intensively without any apparent improvement. On Monday, October 21, the doctor opened several pustules which had formed around the gangrenous area. Two days later these areas showed no healing process. On Friday, October 25 when we first saw him, there had been a marked progression. The entire end of the finger from below the base of the nail was gangrenous. The radial pulse was almost imperceptible and the fingers were cold and blue, with a marked cold perspiration. The history clearly bore out the vasospastic element. The condition was considered an emergency and on Monday, October 28, a left dorsal sympathetic ganglionectomy was performed by the posterior approach. A

large ramus was found running directly from the stellate ganglion into the second thoracic nerve. The stellate ganglion, the second thoracic ganglion and the sympathetic trunk were at least twice the size normally found. Both ganglia and the intervening trunk were removed. On the second postoperative day the radial pulse was markedly stronger and there was at least 50 per cent improvement of the appearance of the finger. The hand was warm, pink and dry. By the fourth day, there was evidence of perfectly adequate circulation in the involved finger up to the gangrenous area. He was discharged on the eighth day. He stated that his arm felt good for the first time in several years.

The actual area of gangrene was not disturbed for several weeks, it was then softened and removed with a portion of the nail. An exposed bit of bone was cut off and in a few days a perfectly healed finger resulted. It is now five months since the operation, the finger is quite normal and he has had no further trouble. Strangely enough, the polycythemic condition has also disappeared and his blood count has remained approximately normal.

We report this case in detail because of the instructive history and the associated polycythemia.

CASE II. M. S. Age forty-five; Russian Jew; married, one child. Occupation: cattle buyer.

Five days before our examination a calf had stepped on his right foot, causing a lot of pain. On taking off his shoe that night, he noticed that his great toe was swollen, blue and very painful. The condition rapidly progressed to an actual gangrene with increasing pain not controlled by large doses of morphine. The case was referred by Drs. Speidel and Rubin. When we saw him, his right great toe was a bluish black color and exquisitely tender. Both dorsalis pedis and posterior tibial arteries were easily palpable. There was no evidence of arteriosclerosis. In the dependent position all of the toes became quite bluish and the great toe became almost black. When the limb was elevated, the toes blanched rapidly. The great toe was very cold and there was a gangrenous area about the size of a ten cent piece on the inner aspect. Temperature studies were made, with the intravenous injection of typhoid vaccine, and he was found to have a vascular index of well over two. Because of the clinical

findings, the rapid onset of gangrene and the severe pain, a diagnosis of Buerger's disease was made.

The patient chose to try a Le Riche operation first. On June 25, 1929, at Columbus Hospital, a bilateral femoral sympathectomy was performed. Both sides were done because of evidence of inadequate circulation in both. The immediate postoperative effect was a marked diminution of the pain and an increase of 9° in the temperature of the involved toe. This improvement continued for about two weeks and then the pain recurred worse than before and the toe appeared much worse.

On August 10 a bilateral lumbar sympathetic ganglionectomy was performed, removing the second to fourth lumbar ganglia inclusive, together with the trunk, and severing all rami on the right side. On the left side the fourth lumbar ganglion was removed. The appendix was found to be almost acutely inflamed but was not disturbed, as the risk was considered too great. When the patient recovered consciousness, the pain had entirely disappeared and he had a feeling of well-being in both extremities. He did well for about forty-eight hours and then developed gastric retention which was relieved by lavage. On the fourth day he was again lavaged. In the meantime his toe had healed remarkably and was 15° warmer than before operation. He had no pain whatsoever. On the fifth day it was evident that we were dealing with a high intestinal obstruction. Surgical consultant advised delay and the next day secondary operation was done. The area of obstruction was found in the jejunum and was released merely by the pull in exploring. The area showed a bluish red band entirely encircling the bowel as though an intussusception had been present. Jejunostomy tube was inserted but patient expired a few hours later. Before death, the toe was practically normal.

CASE III. W. T. Aged thirty-eight; occupation: cook on ocean liner. Chief complaint: Pain and non-healing ulcer of the left hand. During 1928 this man had both legs amputated for a gangrenous condition which was diagnosed as Raynaud's disease. Seven amputations were performed on each leg before the stumps healed properly. For the past year he has noticed that his hands blanched when exposed to cold. About two months ago his left hand became numb and when he rubbed it an intense

pain shot from elbow to fingers. This pain has been present ever since with increasing severity. At the same time he noticed a small ulcer on the second phalanx of the middle finger of his left hand and also one on the tip of the little finger of his right hand. These ulcers have never healed and have grown gradually larger. For the past six weeks he has been taking morphine. At present he takes 12 grains a day and even this does not entirely relieve the pain.

Examination showed these ulcers. Both hands were cold and clammy, the left more than the right. There was good pulsation of the right radial artery but no pulsation of the left. The fingers were blue and mottled. The ulcers were small areas of dry gangrene. Because of his very poor general condition and his addiction to morphine, it was thought best not to do temperature studies. The condition was obviously largely a vasospastic affair but no doubt there was an associated endarteritis obliterans. He was hospitalized, given intravenous fluids, and his morphine intake cut to 4 or 5 grains a day. After five days operation was done.

February 15, 1930, at Columbus Hospital, left dorsal sympathetic ganglionectomy was performed. It was our intention to do both sides but the patient's condition did not warrant doing more than the one. The left stellate ganglion and the second thoracic ganglion were removed together with the intervening trunk and all connections were severed. There was an intrathoracic ramus extending from the second to the first thoracic nerve which contained a ramus from the second thoracic sympathetic ganglion. (This condition proves the necessity of removing the second ganglion to completely interrupt all fibers to the brachial plexus.)

The pain was immediately relieved. The ulcer healed rapidly and the left hand was warm and dry, being warmer than the right. Convalescence was prolonged by gastric upsets due to too rapid withdrawal of morphine. The patient voluntarily refrained from its use entirely until we decided to taper him off to relieve his abdominal symptoms.

It is now two months since operation, the pain has not recurred and the hand is warm and dry. Strange to say, there is absence of sweating over the entire left side of his body and the ulcer on the right little finger has disappeared also. In this case a local removal of the sympathetic chain has effected all the sympathetics

of the same side and also evidently the opposite side. Space forbids a discussion of this peculiar result. Suffice to say, for the present at least, this man is relieved of pain and spared amputation.

#### COMMENT

Of the 3 cases in this group, 2 resulted in remarkable successes and may be listed for the time being as cures. The third, which bade fair to give equally as good a result, unfortunately succumbed.

#### CHRONIC POLYARTHRITIS DEFORMANS

As our cases and results have recently been published, we will present them but briefly. In this series are 4 cases. Two other operations have been done recently, upon which it is too early to report. The reports in those cases that have been treated by sympathetic ganglionectomy indicate clearly that certain types of progressive chronic arthritis are greatly improved by this type of treatment.

The type of case in which the operation is indicated has been quite definitely described by Adson and Rowntree. The condition should be chronic, and all foci should have been removed and all forms of treatment tried without avail. The extremities should be cold and clammy and show excessive perspiration. There should not be marked destructive changes present in the joints.

In our series of cases, only one, the third, fulfilled a few of these requirements. The first two and the fourth were over the optimum age. One in whom we obtained a very good result was fifty-seven years of age. All of them had fairly marked destructive changes in the joints. All of them had been thoroughly treated. The shortest duration of the disease was eight years. All were without means and the first two were county hospital charges. In every case the experimental nature and the uncertainty of the results to be hoped for were stressed, but each one of them was willing to take even the slightest chance of being benefited. They were undertaken for the

purpose of determining whether or not the most hopeless type of case could be benefitted.

The first case was a man thirty-six years of age, with a ten-year history of arthritis. He had been bedridden for over a year, complaining of severe pain in the joints of all his extremities, particularly in the left leg. He had very slight motion in his ankles and his knees. The right hip was fixed. There was typical deformity of the joints with cold painful extremities, requiring constant artificial heat. X-rays showed rather marked hypertrophic bony changes of the joints with some actual destruction of joint surfaces.

Bilateral lumbar sympathetic ganglionectomy was performed at the King County Hospital in August, 1929. Much to our surprise, he was immediately relieved of all arthritic pain in both limbs. There was a temperature increase of  $18^{\circ}$  in the left leg and  $10^{\circ}$  in the right. In less than three weeks he was able to move his ankles. Within two months he had normal range of motion in the ankles; the knees showed almost a normal range, and the right hip, which had been fixed, was freely movable. At the present time, some six months postoperative, he is able to walk a few steps with aid and the atrophy of his limbs is gradually improving. His general condition is poor and his heart badly damaged. He is being built up for the operation on the upper extremities, which are very painful. He has had no pain whatsoever in the legs since operation and the feet are warm and dry.

The second case was a woman fifty-seven years of age, who had had arthritis for fourteen years. The last year she had been unable to walk, being confined to a wheel chair. There was quite severe pain in both knees and marked limitation of motion of all joints of the lower extremities. The upper extremities were less involved and were not painful. X-rays showed the same type of changes as in the previous case.

Bilateral lumbar sympathetic ganglionectomy was performed in September, 1929. There was immediate relief of pain and a marked increase in joint function which has progressively improved. Four weeks after operation, she was able to walk with crutches. When last seen, about six months postoperative, she was much improved. She is able to get about freely with the aid of crutches and

has had no pain since operation. The improvement here is progressive.

The third case was a girl thirty years of age, giving an eight year history of arthritis. She was still able to walk but was rapidly becoming worse. All of her extremities were involved. They were cold and extremely painful and walking was an ordeal. There was considerable limitation of motion and spasticity, with marked atrophy above the knees. X-rays showed fairly marked hypertrophic changes. The skin temperature tests showed a good vascular index, well above two.

Bilateral lumbar sympathetic ganglionectomy was performed at the Pieree County Hospital in Tacoma in December, 1929. After operation, she had no pain, her legs were uncomfortably warm and there was practically normal range of function in all joints. After about one month, during the cold weather, she reported some return of pain. She was seen recently, three months after operation, and is very much improved. The ankles are still rather painful but are improving. She is able to get about with very little discomfort. The feet are warm and dry and the atrophy above the knees has entirely filled in. She is very eager for the same operation for the upper extremities and this will be done soon.

The fourth case was a man forty-seven years of age giving an eight-year history of painful progressive deforming arthritis. The past six years had been spent in Columbus Hospital on crutches, all treatment being of no avail. The picture was very similar to those already described. There was very little motion at the knees and ankles associated with severe pain. The upper extremities were similarly involved. Temperature reactions showed an index of about three.

Bilateral lumbar sympathetic ganglionectomy was done several months ago. The day following operation he exclaimed, "Look, Doctor," and vigorously moved all of the joints of both extremities through an almost normal range of motion which was unaccompanied by any pain whatsoever. The result was too spectacular to last and he very inconsiderately succumbed on the fifth day with complete consolidation of both lungs. This case bade fair to be a most remarkable one. This man had no doubt a very marked muscular spasm probably largely due to the pain of any motion. When this pain was relieved, the spasm

was relieved and he was able to move his joints almost normally.

#### COMMENT

Of the 4 cases of chronic arthritis treated by ganglionectomy 1 unfortunately, succumbed. The other 3 cases resulted very satisfactorily. Two of them were classed as hopeless but they have nevertheless been greatly improved and are still improving. With such results in unfavorable cases, we can certainly expect excellent results in carefully selected cases which fall in the group before mentioned. In practically any case we can be quite sure of a marked relief of pain and a certain amount of improvement in joint function which seems to be progressive.

#### AMPUTATION PAINS, BRACHIAL NEURITIS

The next 3 cases are grouped together because of anatomical similarity. It has been our opinion that in certain forms of brachial neuritis the pains are of sympathetic origin. This question of afferent sensory fibers in the sympathetic tracts has only recently been clarified. At the time of our first operation on the sympathetic nerves for pain, most authorities were agreed that the sympathetic system carried only efferent fibers. Only a few went so far as to admit the possibility that there might be afferent sensory fibers. This conception did not seem reasonable. Since that time the opinion has changed. Much work has been done proving the existence of sensory fibers in the sympathetic tracts and their presence is now generally accepted.

CASE 1. A. B. Aged twenty-eight; motorcycle policeman.

*Chief Complaints:* Paralysis of left arm, third arm sensation, with intense pain in the imaginary arm.

*History:* Six years ago he was thrown from his motorcycle, the head and shoulder forcibly separating. There was immediate development of paralysis of the left arm and soon afterward there developed a third arm sensation with



intense pain in the imaginary arm. The brachial plexus had been explored and many methods of treatment instituted, to no avail. Shortly before coming to us, he developed a definite mental change with a change in personality. The left arm was paralyzed, atrophic and very cold, with a very small radial pulse. There was no motion except a very slight movement of the shoulder. Anesthesia was present up to the shoulder. There was a third arm sensation extending from the left elbow.

Laminectomy with exploration of brachial plexus roots was done February 26, 1929 at Columbus Hospital. All of the posterior roots of the brachial plexus had been avulsed except the sixth cervical, which was curled up within the dura as though severed without, and the first dorsal which was very small. All of the anterior motor roots were absent except the eighth cervical. These three remaining roots were severed. The motor root was severed to insure the destruction of any antidromic pain fibers which might be present. This operation afforded the patient no relief; in fact he was worse afterward. We then determined to sever the sympathetic connections of the brachial plexus. Left dorsal sympathetic ganglionectomy with removal of the left stellate and second thoracic ganglia and trunk was done on March 20, 1929 at Columbus Hospital. The ganglia appeared somewhat enlarged and sclerotic. Recovery was complicated by a mild left upper lobe pneumonia, probably traumatic in origin. There was marked relief of pain during the hospital stay and the patient did not complain of the third arm.

About six months after operation, it was necessary to reopen the wound and remove a number of buried linen sutures. The wound then healed and when last seen about nine months after operation, the patient was working for the first time in the 6 years since his injury. The pain was entirely relieved and the third arm sensation was rarely present. At certain times, under nervous stress or when indulging in alcohol, his third arm bothers him but as a rule he is not conscious of it.

The next 2 cases are recent ones and while it is too early to draw any conclusions from them, they are at least interesting and possibly instructive.

CASE II. A. G. Age fifty-nine. Occupation, saw mill employee. In September, 1927 his

right wrist was severed by a saw. Amputation was done at the time, well above the wrist. Shortly afterward, severe pain developed in the stump and he had a sensation that his hand was present. In January, 1928, the stump was explored and neuromata removed but the pain continued. In May, 1929 he was sent to us by the State of Washington for removal of neuromata. On May, 1929, at Virginia Mason Hospital, the stump was explored under brachial plexus anesthesia. Four definite neuromata were found and removed and the ends of the nerves injected with 85 per cent alcohol. At the time this was done, we felt quite positive it would not give relief and it did not. The pain continued and he was returned to us for rhizotomy. Since the results of rhizotomy in this type of case have been unsatisfactory, it was decided to try ganglionectomy first. At this time he had intense pain running from the imaginary hand into the elbow and the shoulder. It kept him awake and was a constant torture.

On February 1, 1930, at Columbus Hospital, right dorsal sympathetic ganglionectomy was performed. The sympathetic trunk was large. The stellate and second thoracic ganglia were very large and there were several very large rami running toward the cord. Both of these ganglia were removed and all rami severed. We unfortunately made a small opening in the pleura and collapse of lung resulted with hemothorax which required two aspirations and lengthened the convalescence. Before operation the stump was blue, painful and cold; after operation it was pink, not painful and warm, with a 25° increase in the surface temperature. The stump remained warm and pink and free of pain until discharge from the hospital on the twenty-sixth day. The patient was very happy and felt certain that the cause of his trouble had been removed as his arm felt entirely different and he was free of pain. He was last heard from about two months later and was still free of pain and constantly improving.

The next case was one of the few in which our results have not been satisfactory due, we believe, to the mental condition of the patient.

CASE III. H. W. Age thirty. Laborer.

*Complaints:* Pains in arm, neck and head, blindness, deafness, and painful hemorrhoids. Of these and other complaints the thing that



bothered him most and kept him from sleeping was pain in the amputated arm. In June, 1928, a dynamite explosion blinded him, rendered him deaf, and blew off his left hand above the wrist, and the thumb and first two fingers of the right hand. At this time the necessary amputations were performed and he spent over two months in the hospital. Since then he has had several operations for removal of neuromata and portions of nerves without avail. He is totally blind and almost stone deaf. He is bothered with severe constipation and piles and has numerous other complaints referable to various parts of the body. His bitterest complaint, however, is the pain in his amputated arm. The stump was quite warm and there were several palpable neuromata.

While it was not felt that the chance of a good result was very favorable, he was referred to us for sympathectomy and because of his deplorable condition, we felt we were justified in doing it.

Operation, February 8, 1930, at Columbus Hospital, dorsal sympathetic ganglionectomy on the left side. The same structures were removed as in the previous case and the ganglia were found to be quite large, especially the second thoracic ganglion. Convalescence was uneventful except that the patient was very fretful and had numerous complaints. Previous to operation his imaginary hand had felt all knotted up. While the hand sensation was still present, it felt relaxed after the operation. His pain was still present but not so severe and he was able to sleep without narcotics. From his own estimation, it would seem that there was only a 50 per cent improvement as the result of the operation.

#### COMMENT

In all 3 of these cases, of course, the procedures were largely experimental. In each case, however, the patients willingly chose even a slight chance of cure.

In these cases heretofore the pain has always been considered due to an ascending neuritis with an associated neurosis. It has been felt that the pain is central in origin because all forms of treatment aimed at the peripheral nerves have been largely unsuccessful. That there is a large element of neurosis, and that the pain in many of these cases is of a central or psychic

nature, is no doubt true. We feel, however, that the cases reported bear fairly clear evidence that some of them at least are of sympathetic origin. The results of sympathectomy therefore depend largely upon how great an element of central neurosis or psychic pain is present. In the first case of avulsion of the sensory roots there was unquestionably a great deal of the neurotic element present. From a strong healthy man, the patient is rendered a cripple. He is unable to work and his attention is focused night and day upon a useless arm. He becomes depressed mentally and it is not at all strange that he should have pain. However, we feel that in this case circulatory changes and trophic changes account for a great deal of the trouble. With the improvement of circulation and the severing of the sympathetic connections, we have obtained at least a 75 per cent improvement, enough so that he is again a more or less useful citizen.

In the second case, the picture was different. Here was a very fine old gentleman with a cold, blue, painful stump. He was very cooperative and felt certain he would find relief somewhere. In this case there was definite evidence of a probable sympathetic involvement in the cold, blue, clammy stump. Operation has entirely relieved this condition.

In the third case, again, the picture was largely central. This young man was sentenced to a life of blindness, deafness, and inactivity. He was very skeptical of getting relief and at times seemed almost to evidence a disinclination to desire it. His stump was warm and of natural color. Previous to operation, it was felt that our chance of success was slight. What improvement has occurred, however, is felt to be worth while and the patient agrees that it is. It is our conclusion that in certain cases of brachial plexus injuries and neuritis and certain cases of painful amputation stumps, the pain is sympathetic in origin. If one is able to differentiate between the psychic and the sympathetic

types and operate only the latter, the percentage of excellent results should be high.

#### TRIFACIAL NEURALGIA

There is probably no operation in any field of surgery more satisfactory in its results than that of severing the sensory root of the Gasserian ganglion for trifacial neuralgia. Yet all surgeons occasionally meet with the very embarrassing situation of operating for this condition only to have a severe recurrence of pain, in spite of anesthesia of the distribution of the nerve. Although one case is hardly sufficient to warrant any definite conclusions, we feel that the following case would indicate that we have at least reached a probable solution of this problem.

#### CASE REPORT

T. D. Aged thirty-five, married, four children; occupation, laborer. Onset of trouble in 1925. Severe, paroxysmal pain in left side of face, involving second and third divisions of the trifacial nerve. Diagnosis trifacial neuralgia. August 8, 1926 Frazier type of operation performed by Dr. G. W. Swift of Seattle, preserving the ophthalmic division. Relieved for four or five months, then recurrence of pain in upper division. March 21, 1927 the posterior sensory root was severed at a second operation by Dr. Swift. Again relief for four or five months, and then recurrence of pain, worse than ever, in the fronto-temporal region. Paroxysms of pain were very frequent and very severe and no relief was obtainable. In May, 1929, the ophthalmic division was avulsed peripherally by Dr. Greiner of Seattle on the assumption that probably some fibers had been left intact. This operation gave no relief. Patient was hospitalized and large doses of morphine were administered. During this time he three times attempted suicide because of the severity of the pain.

It was noted that during the paroxysms of pain, his left pupil was dilated and the eye seemed to protrude. At other times the pupil seemed slightly contracted. We felt that this was probably a sympathetic type of pain and on June 25, 1929, at Columbus Hospital, Seattle, left stellate ganglionectomy was performed, using the usual technic with removal

of second rib and transverse process. The stellate ganglion was larger than normal and seemed to be quite fibrous. There was a very large preganglionic ramus to the stellate ganglion, which was severed.

The patient made an uneventful recovery and was discharged on the seventh postoperative day. With the exception of some rather severe shooting pains in his left arm, which disappeared after three months, he suffered no inconvenience. It is now almost one year since operation and he has had no recurrence of pain whatsoever.

#### COMMENT

As said before, one case hardly warrants conclusions and probably one year is too short a time in which to report a cure, but we feel that this result is very significant. We believe that it is in the realm of the sympathetics to which we must turn for further treatment in this distressing type of case. It is our hope that others will try this and report their results.

#### ATYPICAL FACIAL PAINS

It is our feeling that a great many of the severe types of atypical facial pain are sympathetic in origin. This thought is not original and is not as yet substantiated by any clinical work. A number of men have been working along similar lines. Peet reports considerable work on the sympathetics in facial pains of vague origin. Both his work and that of other men have not given very satisfactory results. From a study of their work, we feel that we can offer a likely explanation of the inconclusive results. All of them have attacked the sympathetic fibers, either as they run in the carotid sheath or in the cervical trunk and ganglia, particularly the superior and middle cervical ganglia. Those that have attacked the stellate ganglion have done so through an anterior approach. From our work, we feel that in many cases it is anatomically and surgically impossible to completely remove the stellate ganglion by an anterior approach. We feel that where it is reported that the entire stellate ganglion is removed anteriorly, that in

some cases the inferior cervical and the first thoracic ganglia are not fused to form a stellate ganglion and that in reality only the inferior cervical ganglion has been removed, leaving possible sympathetic channels that have not been interrupted. It is our feeling that if further work along this line is done through the posterior approach, positively denervating all sympathetic fibers to and from the head, the results will be much more conclusive. As it is, we believe that many failures are due rather to incomplete denervation rather than a failure of the operative procedure to cure. In other words, we feel that if surgery is resorted to for these types of pains, the surgery must be complete and that until more work and many failures are reported, we are not warranted in discrediting the surgical procedure in this type of case.

#### CASE REPORT

J. B., aged twenty-three, married, one child. Occupation, law student. Referred by Dr. Manford Waltz.

*Chief Complaint:* Pain in right side of face and head.

*Onset:* Four years ago, at which time his nose was broken. Since then he has had periods of very severe pain, extending in a line from the back of his right ear up to and in back of his right eye. This pain is of a throbbing paroxysmal type and at times becomes so severe that he becomes somewhat mentally unbalanced. He has had periods of three or four months without pain, then several months of severe pain. The pain does not seem to bear any relation to any other factor. In March, 1926, a submucous resection was done, with indifferent results. Since then the middle turbinate on the right side has been partially removed and in November, 1929, the remainder of the turbinate was removed with no relief. At this time the pain became very severe and he was referred to us.

Complete general, x-ray and neurological examination revealed nothing. The possibility of Sluder's syndrome was considered and injection of the sphenopalatine ganglion was advised. This was done by Dr. Waltz with no result except an increase in pain and he was

referred back to us for sympathetic ganglionectomy. Because of the fact that the patient was an extreme psychoneurotic, we hesitated. The patient was hospitalized and studied. A few days after admission, the pain became so severe that he went into a semi-delirium and it was necessary to use intravenous sodium amytal for about ten days. The entire nasal condition was rechecked and found quite normal. In the meantime, a psychiatric consultant advanced the opinion that this was purely a functional affair. Finally two factors influenced us to attempt the operation. First, the insistence of wife and parents that something be done, no matter how small the chance of relief; second, the fact that the pain was always localized in the area here described, which corresponded accurately to the course of the ophthalmic artery.

*Operation,* December 29, 1929 at Virginia Mason Hospital. Removal of the right inferior cervical and first thoracic ganglia. In this case the ganglia had not fused to form a stellate ganglion. Postoperative recovery was uneventful and the patient was discharged on the tenth day. Since then he has had various complaints. Hyperesthesia of his right arm with severe pain developed, probably because he had been told he might have pain in his arm. The pain complained of before operation has not returned but he has developed pain in the right side of the nose. He is steadily improving.

#### ATONIC AND SPASTIC CONDITIONS OF THE BOWEL

The results of lumbar sympathetic ganglionectomy in Hirschsprung's disease or megacolon have been favorably reported by many authors. The fact that colectomy merely resulted in a similar dilatation of the bowel more cephalad indicates definitely the neurogenic origin of the disease. The removal of the left second, third and fourth ganglia and trunk has definitely become the recognized method of treatment of megacolon. That exactly the same operation should be used for a spastic condition which is exactly the opposite, seems almost ridiculous. Strangely enough, we have done the same operation for both conditions, with perfect results in each case.

*Megacolon:* T. M. male, aged eleven. Birthplace, West Indies. Referred by Dr. George Miller.

*Chief Complaints:* Severe constipation, awkwardness and stiffness, enlargement, coldness and blueness of legs.

This child was the third of 5; all the others are normal. Very difficult instrumental delivery. The mother noticed that the left leg was larger than the right at birth. Mentally he was fairly bright, possibly slightly less than average intelligence. Always very awkward and unable to run and play with the rest of the children because of the awkwardness which caused him to fall. His legs have always been shapeless, with thick skin and the left buttock much larger than the right. There has been increasing constipation and for the past year; drastic cathartics and enemas have been necessary. The mother states that his abdomen is protruding more and more. The following abnormalities were found on examination: arrested hydrocephalus; the skin of the entire body thick and indurated, especially in the lower extremities, more marked on the left leg and buttock; the legs were very shapeless; abdomen protruded markedly; gait spastic and awkward; hypertonus of musculature and exaggerated reflexes; feet wide and flat, with blunt toes; marked purplish discoloration of the skin of the outer half of the left leg from ankle to buttock; feet very cold and clammy. Diagnosis was made of spastic diplegia, early megacolon, elephantiasis and arrested hydrocephalus. Intensive study revealed no filaria and it was decided that the skin condition was more of a scleroderma type of thing. X-ray examination showed only a moderate enlargement of the colon. Practically all of the findings were thought to be due to sympathetic dysfunction and sympathectomy was advised as a possible therapeutic measure.

*Operation,* July 13, 1929, Providence Hospital, Seattle. Bilateral lumbar ganglionectomy was done, using the transabdominal approach. On the right side the second, third and fourth lumbar ganglia and trunk were removed. On the left side large varicose veins in close association with the trunk rendered complete removal difficult. The second and third lumbar ganglia were removed and all rami severed, as much of the fourth ganglia and as possible were severed and we felt that complete denervation to the limb had been accomplished.

The patient made an uneventful recovery and was discharged on the fourteenth day. There was immediate improvement in bowel function. Within a few weeks the bowel functioned normally every day without cathartics or enemas. The limbs seemed smaller. The temperature of the lower extremities was increased and the feet were warm and dry. The peculiar purplish discoloration had almost entirely disappeared and the gait seemed improved.

The patient was sent to a boys' school in Vancouver, where he received excellent physical culture and was not seen for six months. Six months later, the change was remarkable. The abdomen was flat and his bowels moved normally every day. He had developed into a manly little fellow, his legs were shapely and only a slight trace of the enlargement and thickness of the skin remained. His gait was quite normal and he is now able to run and play with the other boys of his age.

*Spastic Colon:* B. C., aged five, female.

*Chief Complaints:* Convulsions and constipation.

*History:* Shortly after birth this infant began having generalized convulsions. The bowels have always been very constipated and for the past two years daily enemas have been necessary. Convulsions have been both of the petit mal and grand mal types and very numerous. Mental development almost nil, although the child looks very bright. The bowel movements for several years have been in the form of small, hard, round pellets. There seemed to be a direct relationship to the convulsions. When the constipation was particularly severe, the convulsions would be more frequent and much more intense. X-rays showed a small, spastic colon. It was felt that relieving the spastic condition of the bowel might alleviate the convulsions to some extent. Besides these conditions, there was a marked spasticity of the lower limbs, with jerky, purposeless motions.

*Operation,* January 18, 1930, Virginia Mason Hospital. Left lumbar sympathetic ganglionectomy, removing the second, third and fourth lumbar ganglia on the left side. There was a marked enlargement of the second ganglia and a large white ramus to the ganglion was also severed. The sigmoid was entirely retroperitoneal and was mobilized. Uneventful recovery. Milk of magnesia in small doses was used for a

few weeks. For the past two months no cathartics or enemas have been necessary. The child has two perfectly normal bowel movements daily. The convulsions are markedly diminished in intensity. The left limb is much less spastic and is much warmer than the right and seems to show more purposeful motion. X-rays show a normal colon.

#### COMMENT

How can we reconcile the relief of opposite conditions of the bowel causing constipation by exactly the same operation? This can be easily explained on the assumption that the sympathetic innervation of the gut tends to keep it in tone, in other words, tends to keep it in the position in which it finds itself. Furthermore, physiologists have shown us that the organ itself determines its next response to the same stimulus. On this basis in megacolon the dilatation tends to be increased by the sympathetics and in spastic conditions it tends to become more spastic. The spasm of the sphincters due to sympathetic innervation also plays a large rôle. When the sympathetics are severed sphincter spasm is relieved and the bowel is placed in a position of automaticity which places it in the optimum position for proper function. Perhaps this theory is not tenable, but it offers a very likely explanation of our results in these 2 cases.

In the first case, denervation of the sympathetic supply of the limbs resulted in a marked improvement of the spasticity and a marked lessening of the thickness of the skin so that the limbs took on a normal function and normal appearance. In the second case, there is also an apparent improvement in the spastic condition of the limb on the operated side.

#### SUMMARY

Fourteen cases of sympathetic ganglionectomy are reported. In 7 cases dorsal ganglionectomy was done, using the removal of the second rib and transverse process as the approach. In the other 7 cases the lumbar ganglia were removed through a transabdominal approach.

Four lumbar ganglionectomies for chronic polyarthritis resulted in relief of pain and marked progressive improvement in joint function.

Three ganglionectomies for Buerger's disease with vasospasm 2 dorsal and 1 lumbar are reported.

Two cases of amputation pains and one of brachial plexus avulsion are reported in which dorsal ganglionectomy gave some relief.

Two cases of dorsal ganglionectomy for painful conditions of the face are reported. One case of trifacial neuralgia with recurrence of pain after severing of the sensory root has had complete relief for one year. Another case of atypical pain in the face gave inconclusive results.

One case of megacolon and 1 case of spastic colon were entirely relieved by lumbar ganglionectomy.

#### CONCLUSIONS

These results demonstrate conclusively that a large variety of conditions are enormously benefited by sympathetic nerve surgery. The field has not even been scratched as yet. The theoretical possibilities have not been dealt with. They offer so many conjectures that to mention them is to invite ridicule. We feel that many of the major surgical advances of the future will take place in the realm of the sympathetic nervous system.



# INJECTION TREATMENT OF VARICOSE VEINS

## A GENERAL DISCUSSION\*

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MUCH has been written on the history of the injection treatment of varicose veins and for the sake of brevity I will mention the high spots only. Although in reality it dates from the invention of the hypodermic syringe by Pravaz in 1853 yet no definite progress was made in this work until Linser in 1911 noticed that following the treatment of syphilis by the intravenous medication of bichloride of mercury the veins often became sclerosed. Sicard in Paris noticed the same thing when using luargol and from this he later developed the sodium salicylate which has been used so widely. Linser in 1923 changed to a 20 per cent sodium chloride solution which, I believe, he still uses in preference to all others. In 1917 Kausch in Vienna and later Nobl developed the sugar solutions which have recently become very popular.

A word must be said about the etiology of varicose veins. In an earlier article I endeavored to explain all cases on an obstructive basis inferring that garters, etc. were responsible for the varicose formation. Many writers of late have repeated this. I now believe that the majority of cases can best be explained on a congenital basis. By this I mean that the individual has been born with defective vein walls. These walls are competent to withstand the strain until the patient is required to stand on his feet long periods of time; until pregnancy develops with the consequent increase of the blood flow from the uterus; or until an injury occurs causing congestion and inflammation. Under this increased pressure the vein walls give way and typical varicose veins develop. The presence of an endocrine factor cannot be denied

as is proved by the marked aggravation of most cases associated with the menopause. In all our biopsy work we have been unable to find proof of the theory of an infection in the vein wall as the primary cause of the varicosities.

The theory of the treatment is to cause a thrombus formation within the vein, the end-result of which is a complete sclerosing of the vein walls, a thrombus and obliteration of the vein lumen. The cause of this thrombus is still debatable. Some argue that it is a change of the blood constituents, others that it is due to an irritation or injury to the intimal cells lining the vein following which fibrin is laid down and a true thrombus is formed. The exact changes at this point in the development of this clot and thrombus are as yet not definitely settled.

It is a well known and accepted fact that the first requisite for blood clotting and thrombus formation is a slowing or stagnation of the blood stream. With this condition prevailing the presence of infection in the blood stream or the introduction of some foreign body will cause the deposit of tissue fibrinogen and subsequent clot formation. If the injected solution is sufficiently irritating to cause injury to the intima then this reaction takes place more positively and the subsequent process of organization seems to proceed more rapidly. We have proved, however, that this clot and thrombus formation may take place without any *demonstrable* injury whatsoever to the intima. The pathology of this reaction will be developed later on.

The operative removal of entire groups of varicose veins as practiced in the past and according to recognized technic is no longer practiced by the profession in

\* Read before Section of Surgery, The New York Academy of Medicine, March 28, 1930.

general. It is true that there are surgeons here and there who still refuse to have confidence in the injection treatment and believe that it is only a palliative measure. The great majority of surgeons, however, are rapidly becoming convinced of this more modern mode of treatment.

There are many men who still believe in the combined operative and injection treatment. They never inject those varicose veins above the junction of the middle and lower third of the thigh. These surgeons ligate the great saphenous trunk at or near the sapheno-femoral opening and some even advise excision of the great saphenous trunk in the thigh. The remaining varicose segments below this point are then injected with some sclerosing solution. The advocates of this method hold that the preliminary ligation of the great saphenous vein precludes the possibility of the development of an embolus. This, of course, is on the theory that the embolus formation from a portion of the thrombus is aspirated upward from the saphenous vein and into the blood stream of the great femoral. Likewise they do not seem to take into consideration that thrombi can develop at the point of ligature and extend upward as well as from an open vein. Other surgeons, such as de Takats, who are frank advocates of the injection treatment believe in the operative treatment for those cases with extensive varices of the lower leg in which there are many large branches communicating with the deep system of veins. Such cases usually have a Trendelenburg negative test as well as a positive one. In such cases the surgeon raises the skin and then cuts and ligates all the communicating veins that can be found. This is really done radically. With this procedure I emphatically disagree inasmuch as I believe the same or better results can be obtained by the injection treatment alone.

This theory as to the formation of emboli cannot be considered tenable in view of the recent experiments which have been made with the aid of the

fluoroscope and which prove conclusively that the flow of blood in an extensive case of varicose veins is downward from the sapheno-femoral opening and that it enters the deep system or veins through the communicating branches in the lower leg. Any thrombus formed would thus be forced distally and wedged more firmly into the smaller and branching veins below, rather than aspirated upward and onward to the heart. Particularly would this be so when the patient is on his feet and walking about. Likewise it has been proved repeatedly at autopsy examinations that the thrombus following the injection of sclerosing solutions extends upward to the main sapheno-femoral opening and limits its formation very abruptly at that point. This is in accordance with the theory that stagnation is the first requisite for the deposition of the fibrinogen in sufficient concentration for clot formation. The blood flow in the main femoral trunk is so rapid that it prevents these factors from having effect. With the great saphenous so thrombosed from the sapheno-femoral opening downward there would be much less possibility of new varicose formations through collateral veins at this point. They might occur, however, through remaining communicating veins. Recurrences will develop following either the operative or injection method as will be discussed later on.

At the present time most men on the continent prefer to use the salicylate solutions after the method of Sicard, the quinine and urethane after the method of Genvrière, the 20 per cent sodium chloride after the method of Linser, and the sugars as suggested by Prof. Nobl. In this country most men prefer the sugars in preference to all other solutions. Of these there are many different preparations on the market. The most common of these are the invert-sugars 50 per cent, 60 per cent and 75 per cent; equal parts of 50 per cent dextrose and 30 per cent sodium chloride, dextrose or glucose 50 per cent, and the invertose and invertose



compound solutions. The bichloride of mercury has been discarded by practically all clinicians as it has many objectionable features and no advantages over the others.

I prefer the invert-sugar 75 per cent and the dextrose 50 per cent in combination with sodium chloride 30 per cent for the use in the treatment of all extensive cases of varicose veins. The quinine and urethane is then used for injecting the varices that have been missed at the first sitting. These are termed "pick ups." They are also used in cases where there is an occasional small varix. The salicylates and 20 per cent salt have both been discarded on account of the severe cramps which they produce.

The indications for the injection treatment of varicose veins are so broad and the contraindications so narrow that it is only occasionally that we find a case in which treatment is contraindicated.

Pregnancy is no longer considered a contraindication and particularly so during the first four or five months. The patient may not be cured of the veins during that time but she can be relieved from all painful and distressing varices to that she can continue throughout the pregnancy in comparative comfort. All veins remaining following the pregnancy are treated later, usually about three to four months postpartum.

Varices of the labia are often seen during pregnancy and at times are very painful and distressing. These cases are also seen in the non-pregnant woman and may cause pain with each menstrual period. Varices are very amenable to the injection treatment and should be injected if they are painful or cause disability.

The cardiovascular case is on the border line. I believe that no patient should be treated who is so sick that he must lie in bed. We know, as previously discussed, that the first factor needed for the development of a thrombus is a retardation or stagnation of the blood flow and this would be most marked in

the prone position in bed. There would be a real danger here of the thrombus extending into other veins of the deep system with such a poor circulation. If the patient has a cardiovascular condition with many large varices causing a stagnation in the lower legs and yet is able to be about I believe the injection treatment of the varicose veins will very definitely and positively increase the circulation of the lower legs and thereby relieve the extra stress and strain on the general system by checking the backward flow of blood.

The patient from seventy-five to eighty years of age will enjoy being relieved from distressing varicose veins just as much as the one who is thirty years old and there is no reason to fear complications in any form in the elderly patient, following this treatment, any more than in the young person.

The obese person does not offer a contraindication except that it is much more difficult for the doctor to inject an obese person than one not so fleshy. The vein walls in the fleshy thigh are thinner and lie unsupported in the fat. With careful technique, however, this need not be feared. The operator is much more prone to make a perivascular injection and to get a slough formation.

If a patient presents much edema and swelling of the feet this may come from the varicose veins per se or it may be a cardiovascular condition or it may be the result of an old infectious thrombophlebitis. It is in this condition that it is so very important for us to make a positive differential diagnosis and to use the Trendelenburg and Perthe tests as aids. It matters not whether the patient gives a history of one or a dozen attacks of an acute infectious thrombophlebitis as long as the patient has recovered from the infectious and inflammatory condition at the time and as long as he responds to the appropriate tests. Decide each case by itself.

Any patient who gives a positive,



negative, double or nil Trendelenburg test should be injected. Any patient who gives a positive Perthe test may be injected regardless of whether the Trendelenburg test shows a definite reverse flow or not. By this I mean that any patient who has a group of varicose veins which causes stagnation of blood and an increased congestion of the lower legs is better off when relieved from this excess overflow from the venous system. If the Perthe test is positive we know that the deep system is functioning and competent to take care of all the venous blood from the extremity. The general condition of the patient can be improved by relieving the varicose veins which throw an increasing load on the system in general.

The one contraindication accepted by all physicians is the case where a definite, positive, infectious thrombophlebitis has been present at some time in the past, either following confinement or otherwise, and which has left the deep venous system of the leg severely injured or destroyed. In these cases the varices may be entirely compensatory in nature and therefore must be preserved. On the other hand, the mere fact that the patient gives a history of a deep thrombophlebitis must not be taken as a positive contraindication to the injection treatment of her varices which may be present coincident with the former. If the patient responds correctly to the various tests which are used to prove the functioning of the deep venous circulation, and the circulation in the varicose veins which may be present are of a reserve flow, the author sees no reason, whatsoever, why they should not be treated.

Recent cases of thrombophlebitis in the deep system will be a positive and definite contraindication and must remain so until time alone has proved the extent of destruction to the deep circulation and the infectious condition has entirely quieted down.\*Many authors feel that the stimula-

tion produced following the injection treatment may reactivate the latent infection of thrombophlebitis, which at times persists for years.

Many inquiries have been received as to whether or not the deep system would be capable of caring for the increased circulation after the dilated superficial varicosities have been thrombosed and destroyed.

It is undoubtedly not clear to those asking these questions that the blood in the large varicosities is due to an overflow and that it is a part of a vicious circle. As stated before, all this blood has already passed upward in the deep system and should have gone onward to the heart and lungs. Instead of doing so it has run backward as an overflow through a break in the wall or through deficient valves and must again be drawn inward through the communicating veins of the lower leg to again pass upward toward the heart. Thus it is clear how part of the blood spills over and flows backward all the time to fill the varicose veins and it is this overflow of the vicious circle that it is desired to stop. There is no increased demand on the deep veins by the obliteration of the varicosities but rather they are relieved of the excess load of continually carrying upward the blood which they have already passed toward the heart but which ran out through a break in the wall to reenter the deep system below. The superficial venous circulation of the lower leg which is still normal will continue so and will carry the blood upward and into the deep system with the veins protected by valves, and be unhampered by the reverse or stagnant flow formerly present in the varicosities.

infectious thrombophlebitis in the superficial group. This he has done with the theory of completely blocking the patent vein above the thrombophlebitis area with a firm, hard thrombus. This would prevent the reverse flow and pressure from above into the inflamed area and he also believes that there is very little possibility of an extension of the active infection present into the firmly thrombosed veins above. This is a new idea and may prove to be a good one.

\* Dr. E. E. O'Neil of Boston has recently advised the injection of the large veins above the area of acute

*Technic:* The actual technic used in the injection treatment of varicose veins varies, of course, with the individual physician. The majority of those employing this mode of treatment have come to agree that the more empty the vein is of its contained blood and the more concentrated the solution may be within the vein, the better and more rapid the result. Each physician must decide for himself as to how this can best be accomplished.

The advocates of  $\text{HgCl}_2$  (Fig. 1) argue that they should bring the solution into direct contact with the intima. They do this by first introducing the needle into the vein and then compressing the vein wall above the point of the needle as the solution is injected. This momentary contact is supposed to be sufficient. The patient may be sitting, standing or prone with this technic. Immediately after the injection the needle is withdrawn and a sponge strapped tightly over the site of the injection. This gives a good thrombus about 2 in. in length.

Many physicians using quinine and urethane (Fig. 2) simply inject the solution directly into the distended vein with the patient sitting or standing. The percentage of good results is small this way; however, if the vein is emptied of the blood and the flow restrained by the use of tourniquets as the solution is injected, most perfect results will be obtained.

Some prefer (Fig. 3) to make only one injection at a sitting and after entering the needle point into the vein lumen they have an assistant strip the blood from the distended vein with the two index fingers. The solution is then injected and held localized for three to five minutes. If the vein has no collaterals this technic works well but as a rule collateral veins are so numerous that the solution diffuses very rapidly.

Other operators (Fig. 4) use some type of occluder as suggested in Rheil's clinic and by Theis. This is often very satisfactory but I prefer to use a heavy  $\frac{1}{8}$  in. lead wire or soft copper tube. This can be

moulded to the segment treated and then held by an assistant.

I prefer to use the effect of gravity to

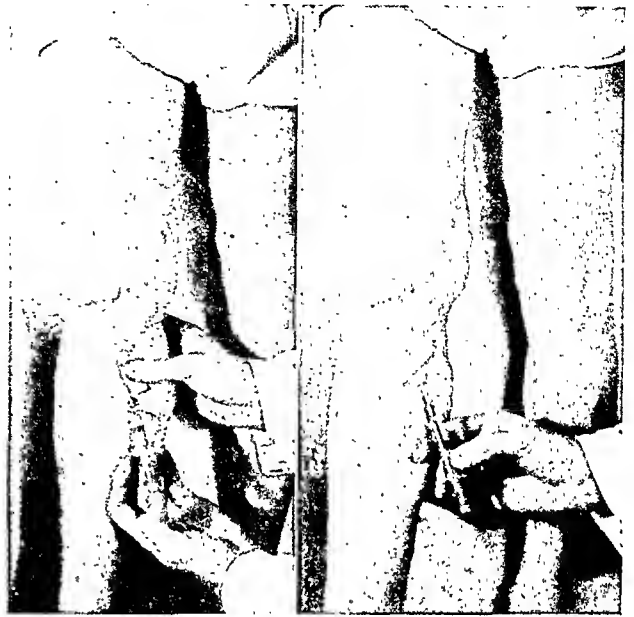


FIG. 1.

FIG. 2.

FIG. 1. Technic for injecting bichloride of mercury. This is best done by introducing needle into distended vein and then injecting solution with vein walls collapsed by thumb pressure as shown. This may be done with patient either sitting or standing.

FIG. 2. Injection of varicose veins with quinine and urethane. Most operators do this with patient standing and inject directly into filled vein. Author prefers to inject solution into empty vein and with use of tourniquets as with any other solution.

empty the vein as much as possible and then retain the solution locally by the use of tourniquets. The leg may be dropped below the level of the table or the patient may be asked to sit up if more back pressure is desired to offset the pressure under which the solution is injected. In view of the experiments with the aid of the fluoroscope which demonstrated that any movement of the muscles of the leg, raising of the head or raising of the body tended to cause a reflux of the injected solution, forcing it out of the varicose veins and into the deep system, I have considered that the patient be absolutely relaxed and in the reclining position during the injecting process. This, it seems to me, keeps the solution from being diluted with blood and also prevents dissemination of the injected solution into the deep veins

until it is desired. I therefore keep the patient absolutely relaxed and motionless until the desired sclerosing effect has taken

result as we get by the more clumsy technic of holding on the syringe, speeds up the work, demands less syringes, and removes



FIG. 3.

FIG. 4.

FIG. 3. Needle introduced into distended vein and vein then stripped empty by assistant. Solution then injected and retained locally by digital pressure.

FIG. 4. Use of soft lead wire to retain solution. It is similar to the Theis occluder.

place. This takes from three to five minutes. As the needle is withdrawn sponge pressure is made at the site of the injection and held in place with adhesive. Firm pressure is made over this sponge for another three to five minutes to be sure of no leakage and of the needle tract being closed by a clot. The sponge is removed twenty-four to forty-eight hours later.

It was recently suggested by one of my assistants at the clinic\* that instead of holding the syringes with the needles in the vein following the injection and while allowing the sclerosing fluid to act that the needles be forced through the vein and thus transfixed (Figs. 5-7). This would then leave the shaft of the needle plugging the opening in the proximal side of the vein so as to prevent perivascular leakage and with the point of the needle resting in the tissue beyond the vein thus preventing the blood and fluid from leaking backward through the needle lumen and on to the skin. It accomplishes the same

the possibility of leakage if the assistant inadvertently withdraws the needle from the vein wall while holding it *in situ*. The latter is the most frequent cause of periphlebitis and sloughs and is often unrecognized, at the time.

The technic just described is that preferred with any solution that I may use and whether one or many injections are to be made at a time. Some prefer to make only one injection at a sitting and repeat every two to four days. There is no real objection to that idea. I prefer, as a rule, to treat the entire case at one time, whether on one or both legs. If the condition is very extensive on both legs then one leg may be treated on one day and the other leg a few days later.

The ideal thrombus is about  $\frac{1}{4}$  in. in diameter as experience has shown that a thrombus of this size organizes more rapidly. It seems clear that it should take a large thrombus much longer to become organized and absorbed than a small one. It is also clear that there is a much greater

\*Dr. Elmer M. Ruston.

possibility of recanalization of the large thrombus than of the small one. If the veins are size one then no attempt is made

As with any surgical procedure complications still arise and probably always will. The most common complication fol-



FIG. 5.

to collapse them other than at the sites of puncture. If they are large an attempt is made to compress them so that the thrombus may be small when formed, thus markedly shortening the period of organization. Often the entire vein is collapsed by the use of multiple strips of adhesive from groin to ankle (Fig. 8). This has the added effect of "sausagizing" the vein into segments and thus still more precluding the possibility of embolus formation. Elastic stockings should not be worn for the first two days following the treatment but may be used after that. If used from the first they would completely empty the varices and oftentimes no thrombus will form at all. It has been suggested that if the injury to the intima were severe enough we might have the walls of the vein adhere and close the vein without a thrombus formation. Our biopsy sections have failed to show this in a single case and I do not believe that it occurs.

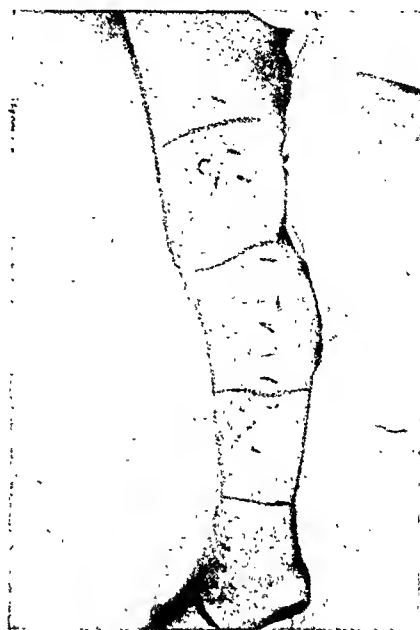


FIG. 6.

FIGS. 5 and 6. Typical case of varicose veins first appearing in mid-thigh. Typical great saphenous involvement. Circular markings are where tourniquets would be applied while separate markings are on loops to be injected.

lowing the injection of the sclerosing fluid is the periphlebitis along the course of the injected vein. This comes from 1 of 3 different causes: (1) The direct injection of the sclerosing fluid outside the vein; (2) leakage of the injected fluid through a needle puncture in the wall of the vein either where the needle has transfixed the vein and thus punctured the posterior wall unintentionally or where through careless technic compression has not been maintained sufficiently long at the site of the injection after withdrawal of the needle to allow the needle puncture in the vein wall to become sealed with the clot; (3) by the direct passing of the sclerosing fluid through the wall of the vein where the vein wall was extremely thin or where the fluid was injected under undue pressure. This periphlebitis usually is not severe and as a rule is of no particular consequence other than causing the patient some mental distress and local soreness. As a rule it reaches its height on the second day

and has practically disappeared by the fifth to sixth day unless a definite amount of the fluid has been injected perivascularly.

If a periphlebitis does develop external support in the way of bandages or adhesive strapping and localized, moist heat will



FIG. 7.

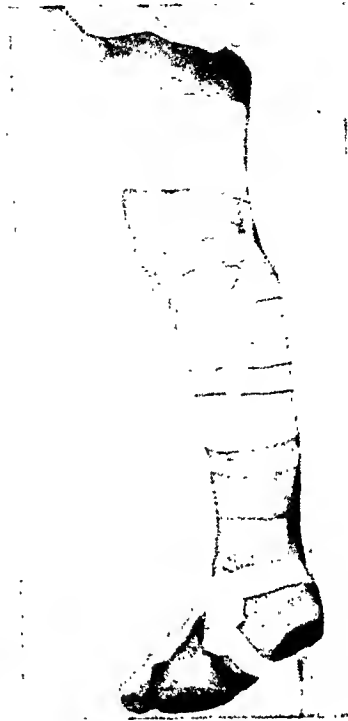


FIG. 8.

FIG. 7. All varices treated with tourniquets remaining *in situ* following last group of injections. The needles are left *in situ* and transfixed through vein preventing leakage. Varix punctured carelessly at one point. Immediate sponge pressure maintained by index finger as shown to prevent leakage.

FIG. 8. All needles removed and sponge pressure applied and held firmly in place with adhesive straps. This prevents leakage, saugagizes vein and maintains pressure support throughout at least 48 hours during period of thrombus formation.

The amount of fluid injected perivascularly needed to produce a severe periphlebitis or a true destruction of the tissues and a slough will, of course, vary according to the particular solutions used. With the bichloride this needs to be only a very small amount, probably not more than 1 or 2 minims, with 20 per cent sodium chloride 8 to 12 minims, and with the sugar solutions 2 to 4 c.c.

Some authorities have stated that periphlebitis and sloughs will not occur with accidental perivascular injections of the sugar solutions. With this I cannot agree for I have seen them myself. It is true, however, that the sugar solutions are by far the safest of all those used and have less likelihood of causing complications.

give much comfort. Ice packs at times are more comfortable than heat. If this condition is present in the lower leg the ace bandage or an elastic stocking serves the purpose well. If it is present in the large veins in the thigh strapping with strips of adhesive 3 in. wide extending about half way around the thigh is best (Fig. 9). This gives the added support and is very comfortable to the patient when on his feet. If the condition is very severe then rest in bed with continuous hot packs terminates the condition more quickly. This, however, I try to avoid in accordance with the theory of clot formation previously discussed. I believe that the thrombus is more limited to the varicose veins and that there is less likelihood of its

extending further with the patient up and about. This also precludes the possibility of embolus by aspiration from the great saphenous. If a slough develops excision and immediate suture with non-absorbable sutures is probably the quickest way out of the difficulty. They, however, undoubtedly cause a larger scarring and more pigmentation than will follow the usual course of letting the slough separate and heal under the usual dressings. I believe sloughs can be avoided by very close attention to a careful and proper technic. They will always happen in the hands of men beginning this work until they learn the fine details.

Fatalities directly due to the injection treatment no longer occur or at least those due to the formation and development of a pulmonary embolus are very rare. It must be admitted, however, that they have occurred and I was so unfortunate as to have one develop in a case that I had treated personally. This occurred while the patient was up and walking about on the lawn. The patient had a positive Trendelenburg reaction and the blood flow was downward from the sapheno-femoral opening. It is thus clear that we most certainly did not get the embolus by aspiration upward from the saphenous system. This also lends weight to the theory (which I have never seen quoted elsewhere) that when emboli do occur from varicose veins they are aspirated inward through the communicating veins into the deep system and then upward toward the heart. Violent exercise could break off a limb or branch of this thrombus resting in the veins as the branches of a tree, yet it is very plausible that this would rarely occur when the patient was going about his usual work.

It is also true that fatalities are continually occurring secondarily and associated with this treatment. It is just as important or more so that the most extreme asepsis be maintained throughout this treatment as when giving any type of intravenous medication or therapy. This, however, is

oftentimes entirely disregarded and the work is done in the most careless, slipshod manner with no attention paid to asepsis



FIG. 9. Typical case of varicose ulcer fed by group from venous system from groin to ankle. Varices size 4 at groin to knee and size 3 from knee to ulcer. Very extensive. Typical wide strips of adhesive applied for support during the ten days following the treatment.

whatsoever. It is also plausible that the infection may be hematogenous from some infection present in the stagnant blood in the large varices at the time of the injection so that the thrombi themselves become directly involved as in any case of acute infectious thrombophlebitis.

In one case recently seen in consultation a staphylococcus infection had developed in all the large varicose loops from the lower leg to the groin and on opening these, typical staphylococcic pus was obtained. The patient developed a typical pulmonary embolus with infarct and died three days later of a right lower lobar pneumonia. The findings were those of a septic infarct formation rather than of true pneumonia. The source of this infection could not be traced yet there is no question but that it

was there and that in all probability it was introduced at the time of the injection treatment.

Another fatality recently occurred in a case where the treatment was given contrary to all rules of the game. In my opinion this fatality was entirely needless. The patient was seen with a very severe acute infectious thrombophlebitis of the veins in the lower leg. She was sent home to bed for the usual treatment with hot packs, rest and elevation. Ten days later two injections of a sugar solution were given. Following this the patient developed a severe reaction locally which suggested the formation of a hematoma or a perivascular infiltration. This was subsequently incised for drainage. Following this further injections of bichloride of mercury were given. The patient's general condition was steadily downward and ten days later she developed a general septicemia evidenced by four successive positive blood cultures. All authorities agree that no case of acute infectious thrombophlebitis should ever be submitted to the injection treatment for his varicose veins until weeks and months have proved that all tenderness and signs or evidences of the acute infection have entirely disappeared. Some authorities even go as far as to say that no case having had an infectious thrombophlebitis should ever receive this treatment. I do not subscribe to this drastic stand, however, but believe that the clinical and careful examinations and study of the case at hand should settle this point.

Recurrences will continue to develop following the injection treatment just as after the operative treatment. In connection with this point it is very important that our records be made more thorough at the time of the first examination. If the patient returns at the end of one, two, or more years and shows a varicose vein formation it is very important for the physician and his reputation to be positive as to the point whether this is a new formation or whether it is a recurrence of the old. Carefully prepared records

at the time of the first examination will usually settle this point. Oftentimes the new formation is a vein lying parallel with the one previously injected. This often happens in the lower thigh and also just internal to the tibia. The previously treated vein may be only a remnant or a fibrous band yet clearly distinct from the new formation. Such a case could easily be classed as a recurrence by the doctor as well as the patient and usually would be so recorded.

Recurrences develop due to either weak and mildly irritating solutions or to the fact that the case was not treated drastically enough at the first sitting. By that I mean the case was treated by the single injection method and by the use of a solution that obliterated a small portion of the vein at a time. The collateral veins would continue to dilate almost as rapidly as the other veins would be thrombosed. If the solutions are injected into large varices size 4 or larger which are filled and distended with blood it is certainly most logical that we would not have the solution in sufficient concentration to give results. Finally some veins are very resistant to sclerosing solutions and may need several injections. Recurrences and new varicose formations are treated just the same as new cases would be, using the technic just described but a more highly irritant solution. Persistence and vigilance here spell success.

When checking up on a previously treated case it is important to keep in mind the fact that if the etiological factors are still present in the individual case which caused the varicose formation to begin with, whatever they may have been, then it is very logical to expect more and new varices to develop. This should be explained clearly to the patient. When a dentist discharges a patient with all cavities filled he does not tell him he will never have another cavity form. The same holds true for a patient having varicose veins.

There has been much discussion as to



the pathology developing following the injections. This has been studied in much detail in cooperation with Dr. N. H. Lufkin, pathologist at the Minneapolis General Hospital and associate in pathology at the University of Minnesota. Biopsy specimens have been made in more than 60 treated cases. In all, over 900 sections of these specimens have been studied. These have been taken at intervals of from one hour to two and one-half years after the date of the injection.

The biopsy specimens removed at one and two hours showed nothing more than a simple, red thrombus. No apparent pathological change had taken place in the intimal cells. The clot or thrombus at this stage was soft and was not firmly attached to the endothelial layer.

Specimens removed after twenty-four hours showed somewhat different results depending on the solution used. Those specimens taken after the injection of 75 per cent invert-sugar and the 20 per cent sodium chloride showed a definite, early thrombus formation through a small area at the immediate site of the injection. This was a true laminated thrombus. Two centimeters away we found a simple, red thrombus with no sign of hyalinization. Only occasionally were leucocytes found infiltrating the subendothelial layers. At the site of the injection with the quinine and urethane the endothelial cells were actually destroyed for a distance of about 1 cm. and there was more leucocytic infiltration of the vein wall than with the other solutions. In this area a true thrombus was found with large islands or prolongations of blood platelets. Beyond this point the same red thrombus was present.

In other sections of specimens removed at intervals of five, ten, twenty days and later, after the injection, the thrombus was seen to continue organization. This organization seemed to proceed most rapidly at the site of the injection and then extend along the vein, involving the red thrombus so that the ultimate end-

result was the same in both cases: a complete organization of the vein with the obliteration of its lumen.

The work done abroad and reported on this same subject was after the use of bichloride of mercury, which is a very severe protein poison. In all those cases it was reported that the endothelium went through a stage of cloudy swelling and was sloughed off. A somewhat similar condition was found by us with the quinine and urethane injections but not with the other solutions. This later finding agrees with the clinical results; by that I mean that the thrombus is harder and firmer following the quinine and urethane or the bichloride of mercury injections than after the sugar or salt injections. This work has been reported more fully elsewhere.

And now we come to varicose ulcers, that common but painful and disabling complication of varicose veins. It is in this field in particular that I feel we have made such improvements in the method of treatment.

It is now generally accepted without question that varicose ulcers are merely the end-result of the stagnation of blood in the varicose veins with a waterlogging of the tissues with lymph and edema, combined with the products of combustion giving a local acidosis. There is thus produced a local trophic state far below normal. The element of trauma or infection added to this lowered resistance of the tissue is sufficient to cause a tissue breakdown and ulcer formation.

If this theory is correct then the ideal treatment should be to eliminate the reverse flow of blood in the varicose veins and raise the trophic state of the tissues near to the normal. This is quite easily done and the resulting rapid healing of the ulcer is often very surprising.

The ulcers and tissues about them are usually badly infected. A local cellulitis is always present and the condition is very painful and tender. With this condition present it is best to delay the injec-



tion of the varicose veins both due to the theoretical possibility of an infectious thrombophlebitis developing and to the fact that the veins will respond to the injection treatment better after the cellulitis of the tissues has cleared up. In the average case this takes but a few days and then the injection of the veins may be done as in the uncomplicated case of veins.

The time honored treatment of varicose ulcers has been to put the patient to bed with the foot in high elevation and apply hot packs. It is true that this has often given good results but the patient is bedridden and necessarily kept from work. Others have applied the Unna's cast or boot over the ulcers and then let the patient wipe up the discharge as it ran out of the cast. This has also given good results and is still the routine treatment in many clinics. Both of these have now given way to the more modern supportive treatment by means of the rubber sponge or "venous heart" and the ace elastic bandage. The varicose veins are then injected at any time throughout the treatment as may best suit the doctor and the patient.

Any treatment so radically different as this should be explained more fully. In the past the patient has been kept in bed with the foot in high elevation. Here the patient is instructed to walk and told that the more he walks the better he will feel and the more rapidly he will get well. He is also told that the more he walks the more quickly the pain will leave him.

The blood in the superficial veins normally passes both upward to the sapheno-femoral opening and inward through the communicating veins to the deep system. With each contraction of the calf muscles on walking the contained group of deep veins are tightly squeezed and the blood therein is forced upward through the femoral vein toward the heart. During the period of relaxation of the calf muscles the deep veins have a negative pressure and fill again from the extremity and the

superficial group. In the case of varicose veins large varices are continually refilled by the reverse flow downward through the saphenous vessels so that the total volume of blood in the large superficial group of veins of the lower leg remains the same. In addition to the stagnation of blood in the large veins the walls of the capillaries have lost the function of containing the fluid portion of the blood and the tissues are saturated both with this and with lymph. By means of the rubber sponge or "venous heart" this is all corrected.

A good grade rubber bath sponge is selected of a size larger than the ulcer. Some soothing ointment is applied to the ulcer surface. Fluffy gauze dressings are applied and a few layers of sheet wadding. Over this the rubber sponge is applied and bound in place with a plain gauze bandage. Be sure that it does not slip and have it come 1 in. below the edge of the ulcer. Now apply the 4 in. ace cotton elastic bandage starting at the knee and going downward with a double figure of eight about the ankle. This is very important and should be low. This is applied as tightly as possible at first and then more loosely as the edema disappears. The rule to follow is "The more the edema and cellulitis the tighter must be the bandage and the more must the patient walk." It is often difficult to convince the patient of the sanity of this radical change from the treatment he has always used, yet therein lies your success. Often the pain in an extensive case will be gone in an hour and after a 10 to 12 block walk. If it returns again after lying down have the patient get up and walk about the room a few times and go back to bed.

The mechanics of this treatment is merely preventing the reverse flow of blood from the sapheno-femoral opening into this ulcer area by the use of the tightly wrapped bandage combined with the rubber sponge which gives a firm but very soft and even pressure over the ulcer and edematous area which gradually forces the fluid out of the tissues. The

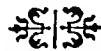
walking of the patient with the resultant constriction of the calf muscles keeps the deep veins emptied and this carried away the fluid forced out of the tissues by the sponge. The bandage holds the whole leg, sponge, etc. in a cast in which the rubber sponge is the only elastic part which can give as the calf muscles are contracted. It also gives a very constant and even pressure all the time. In other words the patient's heart will force the arterial blood to the extremity with its food and oxygen and my rubber sponge acting as a "venous heart" will pump the venous blood inward and upward giving rise to a normal trophic state of the tissues and a rapid healing of the ulcer.

During the past year I have become convinced of the value of the use of iodine in the treatment of varicose ulcers. I cannot explain this on any other basis than that it aids the absorption of scar tissue and thus softens the tissues in general. All ulcer cases are now given 10 drops of saturated solution of potassium iodide three times a day after meals as a routine.

The Braun type of implantation seed skin graft is used as a routine in all the ulcer cases and often with good results. Some cases will need further preparation and grafts of the Riverdin, Thiersch or Wolf type.

In conclusion let me say that as is true with any great step forward errors have been committed, yet improvements in technic have been developed, more ideal solutions have been found and in general the road paved for advancements. Many men have attempted the treatment with no experience and some without ever having seen or read about the method. It has been done by men incompetent of doing any type of intravascular medication and it has been attempted by those having no knowledge whatsoever of the action of drugs or of the pathological process developing following the treatment. Claims have been made for the treatment which, of course, are most unjust and unfounded and which can only be obstacles to its improvement and use. Complications have developed which now can be avoided. The percentage of recurrences has been cut down by better technic and the fact has been recognized that new varices may develop even though the patient has an ideal and perfect result in all varices treated.

With these facts in mind we must accept the injection treatment of varicose veins as a mode of therapy here to stay and as a great step forward from the disfiguring and at times almost mutilating operative procedures of the past.



# LEAD POISONING AND THE EIGHTEENTH AMENDMENT\*

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THE rarity of the occurrence of lead poisoning in surgical practice is a commendable reflection upon the physicians in general practice. Probably a large proportion of patients with this disease are first seen by their family doctors. Surgeons rarely have an opportunity to differentiate the acute toxic episodes of lead poisoning from the acute surgical abdomen.

A recent anonymous article<sup>1</sup> mentions the industries and trades in which lead poisoning most frequently occurs. Allusion is also made to a number of deaths from lead poisoning in rural communities in the State of Maine from water which had run through lead pipes. Regarding the causative factor, a report of the Massachusetts State Board of Health in 1898 is of interest:

A review of results of all the experiments indicates strongly that the two active agents in the waters, causing them to take lead into solution, were oxygen and carbonic acid. The purer the water (for instance, distilled water), the more active these agents were upon lead in the water. The presence of nitrates and ammonia in distilled water together with the free access of air caused a very violent action upon the lead to take place; but they had much less influence when present in natural waters containing some organic matter.

The fact that nitrates and ammonia are not common constituents of spring and well water probably explains the comparative infrequency of lead poisoning among the larger proportion of rural inhabitants who use water that has been conducted through lead pipes.

Since lead poisoning has been made a compensable disease under the Workmen's Compensation Laws of Massachusetts much interest has been aroused among physicians interested in industrial accidents and diseases.

Statistics compiled and reported by Dr. Alice Hamilton<sup>2</sup> show that in 1913 there were 1770 cases of lead poisoning in 19 plants employing 7500 men with 16 deaths. In the state of Utah in 1919-20 there were 468 cases of plumbism, an incidence of 6.7 per cent in 1919 and 5 per cent in 1920.

The studies carried out by Mayers<sup>3</sup> of 381 lead workers in 23 plants of the leading lead industries in the state of New York should be of considerable concern to employers and physicians to laborers exposed to lead. Mayers found that the lead burners, who were exposed to the fumes of lead oxide show on examination lead absorption in all cases, and that solderers show on laboratory studies no absorption. Of the 381 lead workers studied, 149 were found evidencing absorption of lead clinically, and in 66 per cent of these, absorption of lead was confirmed by laboratory tests.

Aub<sup>4</sup> and his co-workers at the Massachusetts General Hospital have shown in their studies of lead poisoning that storage of the lead is in the calcareous portions of the bones. They have demonstrated that the intramuscular administration of bovine parathyroid extract causes a rapid elimination of lead.

Of the less frequent causes of lead poisoning, snuff<sup>5</sup> has been reported in medical literature by several writers in the past. The lead in snuff was a lead chromate used as an adulterant.

Patients with toxic symptoms from lead contained in alcoholic beverages are occasionally reported in the lay press and in rare instances recorded in medical literature.

In an article by Hargrave<sup>6</sup> citing 5 cases of lead poisoning from painting on the U. S. S. Wyoming, the case of a sailor is reported who developed the disease

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from drinking a native drink called *aqua-diente*, which was distilled in lead lined containers. Knowlton<sup>7</sup> reported a case of lead poisoning resulting from drinking wine through a rubber tube which contained a large amount of lead. A case recently reported to me was of a laborer in a wire mill who developed lead poisoning. Since no exposure to lead could be found in an investigation of his work, his home conditions were studied. It was found that he was drinking wine regularly which he had made in a barrel which originally contained litharge.

Dunphy of St. Vincent's Hospital, Worcester, Mass. in a personal communication reported a case of lead poisoning from cider stored in containers contaminated with lead which the patient had been drinking for two years. He also reported a fatal case of a man who had been drinking wine made in a red lead keg.

Aub<sup>8</sup> stated that lead poisoning has been caused by the consumption of alcoholic drinks containing lead in a few cases. He analyzed 7 samples of distilled liquor and found lead content varying from 9.6 to 52.7 mg. of lead per liter. Of 11 samples of wine analyzed the lead content varied from none to 75.4 mg. of lead per liter. The source of lead in wine making has frequently been due to the use of lead glazed crocks, solder from metal containers and copper receptacles tinned with lead alloy which are readily soluble in the fruit acids. Chevallier and Olivier<sup>9</sup> reported an epidemic of lead poisoning caused by the use of litharge in treating green wine. Campbell and Allden<sup>10</sup> reported cases of plumbism from wine. Vaughn cited cases of lead poisoning from moonshine whiskey which was due to lead condensers in stills. In the illicit manufacture of distilled liquor, lead worms or condensers are said to be frequently used in place of the more expensive block tin worms. Liquor from such sources must necessarily contain considerable lead.

The following case report of lead poisoning is here placed on record on account of the possible frequency of the etiological

factor in the present illicit methods of manufacture of alcoholic beverages. It also illustrates one of the less frequent diseases to be considered in differential diagnosis of the acute abdomen. It is quite possible that a more extensive search for lead as an etiological factor in many of the so-called "scofflaws" who are suffering from symptoms of peptic ulcer and enteritis might increase the incidence of lead poisoning.

CASE 5546. C. G. male, aged thirty-two, works in railroad scrap metal yard. Admitted to the Moore Hospital, October 7, 1929. Referred by Dr. Alexander McRobbie.

*Family History:* Always well up to 1917 when he had pneumonia. Had been well up to May 1929 when he began to have attacks of slight grumbling abdominal pain and moderate pain in many joints. In August 1929 had his tonsils removed with only temporary relief of the arthritis. Has no indigestion. Has lost no weight, bowels normal.

*Present Illness:* Began two and one half days before his admission to the hospital when he was seized with severe pain about the navel radiating to the lower lumbar region. He took a large dose of epsom salts which produced a rather unsatisfactory movement. The following day he felt somewhat better, but vomited two or three times. The second day after onset of the pain he returned to work but during the afternoon had a recurrence of the pain without vomiting.

On examination, patient was found on his hands and knees in bed complaining of mid-abdominal pain. He was quite pale, pupils reacted normally, tongue was coated, teeth very poorly cared for, throat red. Heart and lungs were normal, abdomen was lax throughout with no masses or areas of tenderness. Urine: none to very slight trace of albumin, no sugar, a few leucocytes and moderate number of hyaline casts in the sediment. There were 4,600,000 red blood corpuscles per cubic millimeter. The differential count was essentially normal except for many red corpuscles that had the typical stippling of lead poisoning.

The patient's gums were then examined and found to have a very definite lead line. The non-protein nitrogen was 38 mg. per 100 c.e., blood sugar 0.09 per cent. The Wassermann and Kahn tests were negative.

Furthering questioning of the patient revealed that he had drunk rather large amounts of home brew and moonshine for several months prior to the present illness.

He was given atropine, epsom salts and enemas which resulted in a rapid subsidence of the acute symptoms and he was discharged October 14, 1929. At my request the patient obtained a sample of the whiskey from his regular bootlegger. Chemical examination of this sample showed a content of 5 mg. lead per liter.

Further inquiry elicited the information that many other residents in the vicinity of the city in which the patient lived had in the past and were still suffering from symptoms similar to those with which the patient was afflicted. All attempts to examine or obtain laboratory specimens from any other patients were met with a positive refusal. It would seem however that the same bootlegger had established quite a thriving business.

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\* Continued from p. 52.

# A CLOSED ASEPTIC AND QUICK METHOD OF GASTROINTESTINAL ANASTOMOSIS\*

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THE history of the development of operative procedures directed for relief of diseases of the stomach and the intestine is undoubtedly the most intriguing and fascinating branch of surgery. The gastrointestinal tract, composed of hollow tubes having a varied function and mobility, allows freedom of manipulation to an extent which is not possible with other organs of the body. It is no wonder that the search for the ideal has resulted in a multiplicity of methods, far beyond the dreams of the early surgeon. Kerr<sup>1</sup> reported about 250 methods that had been described up to 1923. Since then, there have been about as many modifications reported in the literature. In the same paper he calls attention to LaFrank's treatise on "Science of Ciruge," published in 1396, in which LaFrank teaches a method of treating intestinal wounds. This relatively ancient work must be regarded as the first milestone in the progress of intestinal surgery.

The next important step in the development of intestinal surgery is the work of Travers, who published in 1812 "An Inquiry Into The Process of Nature in Repairing Injuries of the Intestine." He proved by experiments that healing took place by agglutination of the "visceral peritoneum at the edges of the wound in the intestine, to the parietal peritoneum of the adjacent viscera." He stressed the importance of inverting the peritoneal coats when suturing intestinal wounds. In 1826 Antoine Lembert published in "Rapport General D'anatomie" a chapter entitled, "Nouveau Procédé D'enterostomie," describing a simple and expedient method of anastomosis. He conducted experiments upon dogs, all surviving the operation. He

concluded that his method of suturing is easy, simple, that it maintains firm union, that the constriction formed is small, and finally that the suture does not interfere with function, but causes sufficient irritation to produce a prompt and necessary plastic exudate. Lembert's observations brought out the fundamental principle that healing takes place, not at the cut edges of the bowel, but by the adhesion of the peritoneal coats by a plastic exudate. The soundness of his conclusion is tested by the fact that his method of suture which bears his name is widely used at the present time.

From the foregoing it can readily be seen that the primary principles of intestinal surgery were well established over one hundred years ago. The beginning of present-day gastric surgery had its inception with the experimental researches of Gussenbauer and Winiwarter,<sup>2</sup> who in 1875, at the suggestion of Billroth, successfully performed gastric resection on dogs. Their work stimulated Pean in 1879 and Rydygier in 1880, to attempt the operation upon humans, but without success, as their patients died as a result of peritonitis. To Billroth goes the credit for performing the first successful gastric resection on a patient. This operation is now known in most countries as the Billroth No. 1, whereas in France, it is known as the Pean operation. Another important surgical step was an anterior gastroenterostomy, performed by Wolfer in 1881, for pyloric stenosis in a case with inoperable carcinoma of the stomach. This was, undoubtedly, the beginning and the foundation of the most common operations on the stomach. The bad features of this operation were overcome by Von Hacker, in 1885, by doing a posterior instead of an

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anterior gastroenterostomy. William J. Mayo, in 1905, perfected this by describing a no-loop posterior gastroenterostomy.

A very interesting phase of gastrointestinal surgery is the number of contrivances that have been suggested to perform an anastomosis. Silvestri, in 1862, was the first to introduce an elastic ligature to sustain an anastomosis; this was improved by McGraw, in 1891. Others since have suggested various contrivances: Senn used bone rings; Robson suggested bone bobbin; Harrington and Gould aluminum rings; O'Hara devised a special forceps which he suggested for an end-to-end and lateral anastomosis; Halsted used inflatable rubber cylinders. In 1892, Murphy used steel buttons which permitted rapid anastomosis, with perfect approximation. Its simplicity and quick method had a stimulating effect upon intestinal surgery by making it popular. Many other contrivances have been introduced which are too numerous to mention. It was early proved that it was not advisable to introduce a foreign body to sustain an anastomosis. Of all the methods that have been suggested, the Murphy button is the only one that still has its adherents. In selected cases and for anastomosis of the large bowel the button has a distinct advantage over other methods. For surgery of the small bowel and the stomach, there is danger that the button may become lodged somewhere along its path, thereby causing a mechanical obstruction. Should obstruction occur as a result of the Murphy button even in 1 out of 1000 cases, it certainly ought to be discarded, because of the high mortality which follows obstruction. As a matter of fact, any operative maneuver, which because of its use causes an increase in the operative or postoperative mortality, ought to be shelved.

Another interesting phase of intestinal surgery was the extensive experimental study of Behrend, Bech and Herrmann,<sup>3</sup> to determine which is the best method of anastomosis. They concluded that the end-to-end is the best method; whereas,

when the lumen of the intestines is of different calibers, they suggest a lateral anastomosis. Sweet<sup>4</sup> considers a lateral anastomosis of a thin-walled gut as more logical than an end-to-end, . . . "regardless of the physiology; for we know that adaptation will occur even to the point that the gut becomes in time, even after a lateral anastomosis, a straight tube again." The author in 1928<sup>5</sup> suggested an end-to-end to side anastomosis which combines the technical principles of both the lateral and end-to-end. It eliminates the bad features of an end-to-end and is superior to the lateral in that it takes less time to perform the operation, at the same time retaining its good features. Behrend, et al, in the same study mentioned here, devoted considerable time to aseptic methods of anastomosis and believes that the development in the future will be along this line.

In spite of the great strides made, gastrointestinal anastomosis is still confronted with the highest mortality rate, compared to other operations in the abdominal cavity. The most frequent cause of this is infection, due to contamination or spilling of the contents of an opened gut. The desideratum would be to perform an anastomosis in an aseptic manner by excluding all the dangers attended by the open method. In a preliminary report on the same subject, the author stated,<sup>6</sup> "The open method of anastomosis is attended with a certain amount of postoperative complication and fatalities that are directly due to spilling of contents from the opened bowel . . . An operation must be carried out aseptically to its completion; and this cannot be secured with an opened stomach or intestine." Fraser and Dott<sup>7</sup> consider the insufficient blood supply and the highly septic contents of the large bowel as the factors which render surgery of the colon so dangerous. Of all the various factors, they consider sepsis as the most serious. Fraser<sup>8</sup> described a closed method of anastomosis which he experimented upon



54 animals with no deaths. He also used this method in the human in 14 cases with one death. Pringle<sup>9</sup> perfected a forceps embodying the same principle and concluded<sup>10</sup> that his method is quick and that the risk from infection is much less than with ordinary methods. He used it in 14 cases, with 2 deaths. The first was in a man in very poor general health, with advanced carcinoma of the descending colon, adherent to the lateral abdominal wall and with a pericolic abscess. The other who died was a man aged sixty-eight, with carcinoma of the pelvic colon. He died on the thirty-second day after the operation as a result of thrombosis of the left femoral vein. In no case did Pringle find obstruction due to formation of a shelf. Pringle used a series of mattress sutures, each penetrating to the submucosa burying the forceps from either side. When the instrument is pulled out, the only place where the serous coats are not in contact is at the point of emergence of the forceps. With this method there is danger of inverting too much tissue. Halsted,<sup>11</sup> in 1922, described a method of colectomy which he experimented upon dogs without any failures. His method is very ingenious; he closed the ends of the colon and approximated them with a single row of mattress sutures. The operation is complete by puncturing the diaphragm by means of a special knife introduced per rectum. Highsmith,<sup>12</sup> in 1923, suggested a method similar to Halsted's. He closed the ends of the bowel by a strand of silkworm gut thrown around the intestine in a groove left by a narrow crushing forceps. The strand of silkworm is held in a special loop clamp, similar to a polyp snare. The closed ends are then sutured and the silkworms are cut by the loop clamps and the latter are removed thus re-establishing the continuity of the lumen. This method is an improvement over the Halsted method; nevertheless, it has the tendency to invert too much tissue. Kerr and Parker, in 1923, also devised a closed method of anastomosis.

They invert the ends of the intestines to be anastomosed over a Carmalt type of forceps. The suture ends are not tied, but left long. The inverted segments are then sutured together with a continuous Cushing stitch. After this has been accomplished the original inverting stitches are removed, thus re-establishing the continuity of the lumen. This method leaves a large diaphragm which may cause cicatricial contraction.

Recently, Perret of Berne, Switzerland,<sup>13</sup> described a method using invaginators and coprostatic clamps. The essential point of this method is the crushing of the two viscera to be anastomosed at the same time and with the same instrument. The coprostatic clamps help to hold the bowels together when the invaginators are being applied. The bowels are then sutured over the invaginators with two external, continuous, circular and concentric silk sutures. Perret has used this method in a number of cases in the human with no bad results, such as: hemorrhage; obstruction; or the formation of peptic ulcers at the site of the anastomoses. Rankin of the Mayo Clinic<sup>14</sup> proposed a three-bladed clamp with a fixed central blade, against which the two lateral blades operate independently. When the clamp is in use the posterior peritoneal surfaces of the two arms of the bowel are in direct apposition, separated only by the width of the central blade. After the application of the anterior and posterior sutures, the clamp is withdrawn and the whole line of suture is drawn taut with perfect approximation. Rankin has used this method in 12 resections of the colon with satisfactory results. Secondary hemorrhage or the formation of a diaphragm has not occurred in any of his cases. More recently, Horsley<sup>15</sup> suggested a method similar to the one the author described<sup>6</sup> except that he uses ordinary Payr clamps and interrupted sutures instead of the continuous. The posterior row is sutured first with a continuous stitch by spreading apart the two blades. The clamps are then approximated



and the anterior row is sutured with interrupted mattress stitches. The clamps are then withdrawn and the mattress stitches are tied. He suggests this method in cases that are bound down with adhesions or when the bowel is immobile because of its anatomical peculiarities, and hence the posterior row cannot be sutured as described by Rankin. We have found that the Payr clamps are not easily handled and that the blades are too wide. We have also observed that when interrupted stitches are used the agglutinated septum has a tendency to spread apart when the sutures are being tied. This is especially true if there happens to be distention of the bowels. This would in itself spread apart the diaphragm allowing the contents to escape and contaminate the peritoneum. In these cases with immovable bowel the author's clamps can be used, combined with Horsley's suggestion, of suturing the posterior row first with the clamps spread apart, then locking the clamps and completing the maneuver with an anterior row of Cushing stitches as described in this paper. This would carry out Horsley's suggestion and at the same time remove the objectionable features of his method.

Since Halsted's pioneer work of developing an aseptic anastomosis, about 40 distinct methods have been described. A review of the literature shows that the reason for the failure of these methods to become adapted is due to one or more of the following: (1) time-consuming methods, requiring a great deal of technical knowledge; (2) lack of simplicity in the instrument; (3) some of the instruments suggested disregard technical principles of a closed aseptic anastomosis, thereby defeating the purpose for which the instrument was used; (4) the formation of a too large diaphragm which might cause primary stenosis or secondary cicatricial contraction with diminution of the lumen; (5) disregard of the anatomical peculiarities and differences in surgery of the small and large intestine; and (6) disregard of primary

principles as applied in the standard methods of gastro-intestinal surgery.

The author in the preliminary report suggested the use of two Carmalt forceps which when brought together were locked by a set-screw. It was early proved during the experimental study that the blades were too flexible and not strong enough to crush the diaphragm sufficiently. The present clamps represent an improvement with many radical changes to overcome the objectionable features of the Carmalt forceps. For the crushing effect Payr clamps would be ideal; but they cannot be used because they open all the way or close tightly. This causes the agglutinated septum to spread apart when the clamps are removed and a continuous suture is used, thus allowing the contents to escape. Various forceps were tried and finally the present clamps were developed and perfected to carry out an ideal closed aseptic anastomosis. I am indebted to the makers of the instrument for their suggestions and cooperation in the development of the instrument.

#### DESCRIPTION OF THE INSTRUMENT

The instrument is composed of two separate compound leverage clamps having greater crushing and agglutinating function than the Payr clamps (Fig. 1). When in use the two clamps are locked together by a set-screw attached to the left clamp. In order to prevent motion when the instrument is locked there are two prongs on the leverage part of the right clamp which fit into indentations on the corresponding side on the left clamp. Because of these the two clamps are locked firmly and evenly, allowing ease in handling the instrument in suturing. To facilitate opening and closing, the handles are angulated laterally, because it is almost impossible to do this when clamps or forceps are placed side by side unless the handles are angulated. The clamps also have an abdominal curvature, conforming to the curvature of the abdominal wall, so that

they will remain in the same position they are placed in on the abdomen. The blades are angiotribed with cross serrations to

long enough to perform any type of anastomosis; also to resect ulcers. The clamps are mechanically perfect, simple in design,

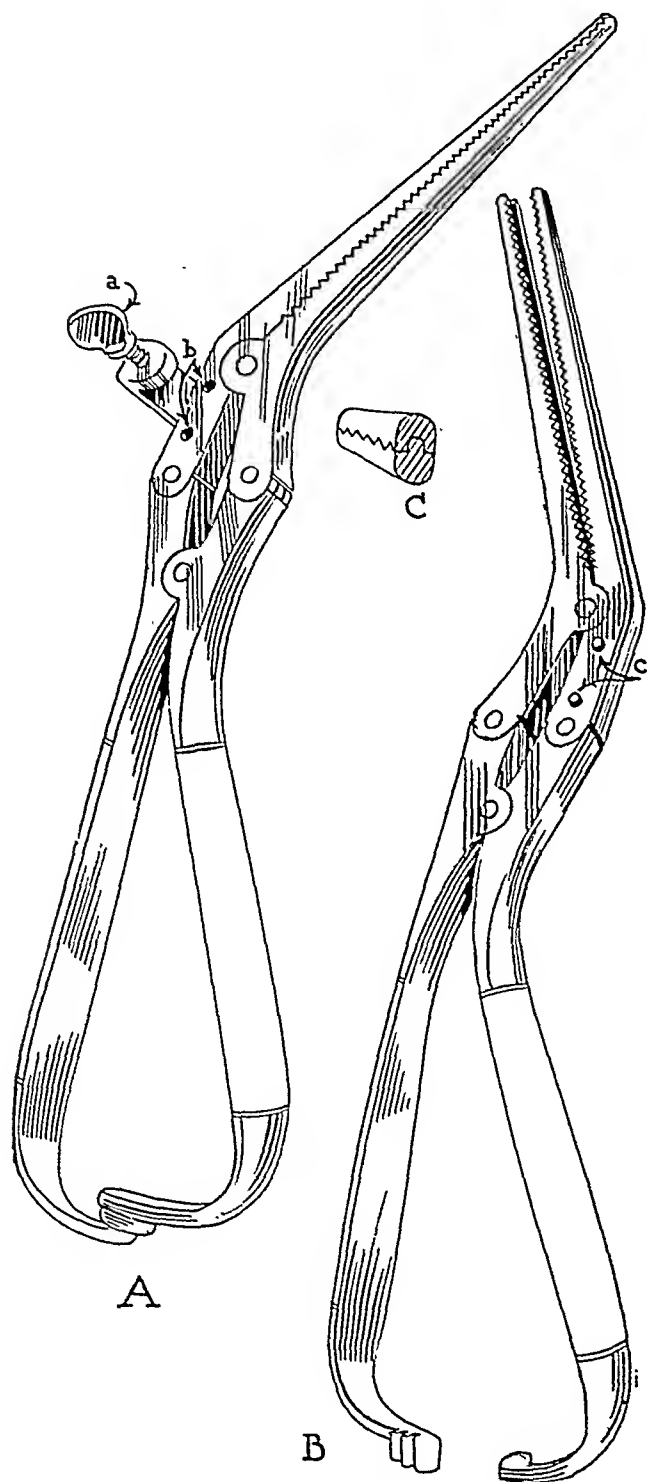


FIG. 1. A. Left clamp with set-screw, a, attached. Clamps have compound leverage with hand grip. On leverage side are two indentations, b. B. Right clamp. Two prongs, c, which fit into indentations on left clamp. c, Cross section of blades.

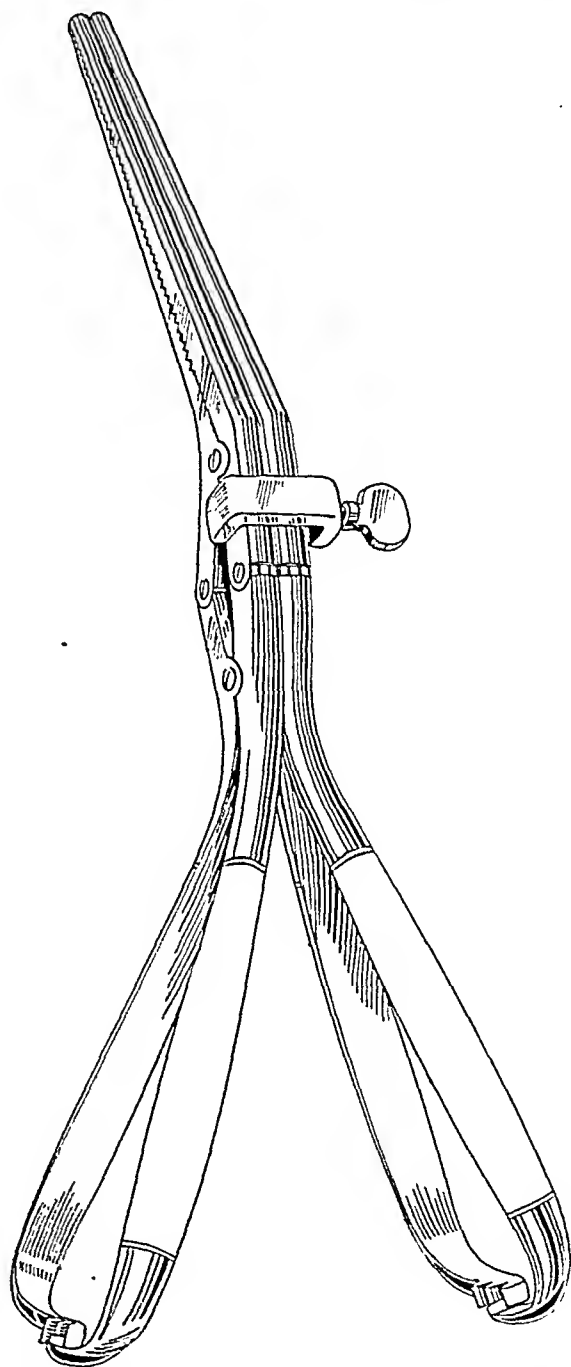


FIG. 2. Two clamps locked together with set-screw. Handles angulated to permit freedom of manipulation. Also has abdominal curvature, conforming to curvature of abdomen.

FIGS. 1 and 2. Description of the instrument.

prevent slipping of the crushed edges. They are 5 mm. wide and 8 cm. in length,

easy to manipulate, hemostatic, and meet the requirements for a closed aseptic

gastrointestinal anastomosis without a large diaphragm (Fig. 2).

### HEMOSTASIS

Hemostasis in an operation is one of the fundamental principles of surgery. Regardless of the operative procedure or the method employed, the danger of hemorrhage is ever present; hence precautions must be instituted preoperatively, during the operation and even after an operation. The blood-clotting time should be determined in all operative cases, because there are people whose normal coagulation time is longer than the average. Patients with jaundice should be given calcium by mouth or intravenously and if necessary a blood transfusion. Our experience with the instrument in this respect has been very satisfactory; hemorrhage has not occurred in any of the dogs experimented upon. The crushing force and the angiotribe blades agglutinate and seal the smaller blood vessels and capillaries. This helps to control bleeding; however, the ligation of the large vessels and the tightening of the suture line are the main factors in controlling hemostasis. The sutures need not be drawn too taut, because edema develops which will tighten the suture line. With the use of this clamp there is not the slightest amount of oozing during the operation, nor does it occur after the diaphragm sloughs.

### METHOD OF SUTURING

One of the great advantages of this method is its simplicity of suturing for the various operative maneuvers. Because of this it is possible to develop maximum proficiency in a minimum time. Although the method is simple, I cannot stress the importance of mastering the technic on the dog before attempting it on the human. I do not believe that we can repeat too often the gospel preached by Murphy, that a surgeon should not attempt a new method until he has developed sufficient skill on animals. Adherence to this will

result in fewer disappointments and greater ease of mind.

The suture used for the various methods described in this paper is essentially the same as the Kerr-Parker method of inverting the ends of a lateral anastomosis. After the clamps have been applied and locked together the anterior row is sutured first, although there is no objection to suturing the posterior row first. The anterior row of suture is started at the tip of the right blade with a Lembert stitch, i.e., at right angles to the line of suturing. This is not tied, but is continued as Cushing stitches. The latter are inserted parallel to the line of suturing  $\frac{1}{8}$  in. from the blades and  $\frac{1}{8}$  in. apart, first on one side of the bowel, then on the other. It ends as a right angle stitch at the leverage side of the left clamp. The posterior row is sutured in the same manner except that it is started at the leverage side of the right clamp and ends at the tip of the left. All the ends have Lembert stitches which facilitate inversion of the corners. At the tip of the blades there is the short end of the anterior and the needle end of the posterior sutures; whereas, at the leverage side will be the short end of the posterior and the needle end of the anterior. As the clamps are being removed the assistant draws on the suture ends found at the point of the blades. In order to aid inversion of the corner these sutures are pulled in a cross direction; in this manner the edges of the bowel will be drawn together rather than pulled apart. The operator controls the other suture ends, but does not pull on these until the blades are almost out. The withdrawal of the instrument and the pulling of the sutures should be done simultaneously so that there will be inversion of the edges as the clamps are removed. After the instrument is completely withdrawn the suture line is drawn taut and the ends are tied. These sutures do not penetrate the entire thickness of the bowel wall, but just down to the mucous membrane. Because of this an entirely aseptic anastomosis can be carried

out with the least possible danger for peritonitis to develop from contamination or spilling of the contents. The operative maneuver is completed by inserting a second outer row of Cushing stitches.

#### INTESTINAL HEALING

We have not attempted to make a detailed study of the healing process of intestinal wounds, because this has been sufficiently studied by Sabin, Grey, Gatch, Connel, Mall and others. The main object of our experiments was to develop an instrument which would: (1) perform a closed aseptic anastomosis adhering to the principles of gastrointestinal surgery; (2) cause the diaphragm to slough within forty-eight and not later than seventy-two hours; (3) that it would not, per se, cause postoperative complications such as ulcers and hemorrhage.

Sabin<sup>22</sup> in 1920, made an extensive experimental study involving 27 anastomosis. She found that with perfect apposition of the resected ends there is little need for regeneration of the mucosa, and that the gap in the submucosa is covered over by a layer of cuboidal epithelium at the end of four days. By the end of the seventh day the mucosa is bridged by simple glands, embryonic in type, often several layers deep. Villi appear about fourteen days after the development of these glands. Graham, quoted by Rankin,<sup>14</sup> conducted experiments to determine whether the Rankin clamp for closed aseptic intestinal anastomosis of the colon was more satisfactory than the usual open methods. In the open-method group all the animals died as a result of peritonitis within five days, whereas with the closed method none showed evidences of peritonitis. Mall observed that the diaphragm when under pressure is destroyed by necrosis at the end of the fifth day.

Our series of experiments were conducted on dogs on whom we performed the following operations: gastroenterostomy, resection of ulcers of the stomach and

duodenum, end-to-end and lateral anastomosis of the small bowel, colocolostomy, and ilioocolostomy. The greater part of the experiments were resection of ulcers and gastroenterostomy, because these have not been experimented upon by other workers utilizing the principle of a closed aseptic anastomosis. Ether anesthesia was used for all the animals. Gauze packs were not used to wall off the peritoneal cavity. The ends of the gut within the clamps were cauterized with phenol and alcohol. We found that soon after an operation there is a deposit of lymph on the serosal layers of the anastomosis which is soon transformed into fibrin. In none of the animals did we find evidence of peritonitis or union by granulation tissue. Only one of the animals develop a distemper forty-eight hours after an end-to-end suturing of the small intestine. Because of the grave condition of the animal his abdomen was opened. There was no evidence of peritonitis or leakage. The jejunum was dilated to the point of the anastomosis and contracted distal to this point. The anastomosis showed signs of healing, but a large splinter of wood was found which became lodged within the anastomotic opening. This was purely a case of mechanical obstruction which certainly would not have occurred had the animal been properly prepared before the operation. Examination of the stomach tissues after gastroenterostomy and resections showed that at the end of the third day the ends healed without any inflammatory reaction. Proliferating fibroblasts and capillaries of the serosa had established a firm connection between the sutured ends. The diaphragm for the various types of anastomosis sloughs from forty-eight to seventy-two hours. This is a very important function of the clamps, because should the diaphragm be allowed to remain longer there is danger of cicatricial contraction of the lumen. The angiotribe effect of the blades and the leverage strength of the clamps exert sufficient pressure, completely destroying the dia-

phragm by pressure necrosis. Examination at the end of the third or fourth day shows a clean-cut surface without any

be used for any type of anastomosis with this exception; it cannot be used after a wide resection of the stomach in

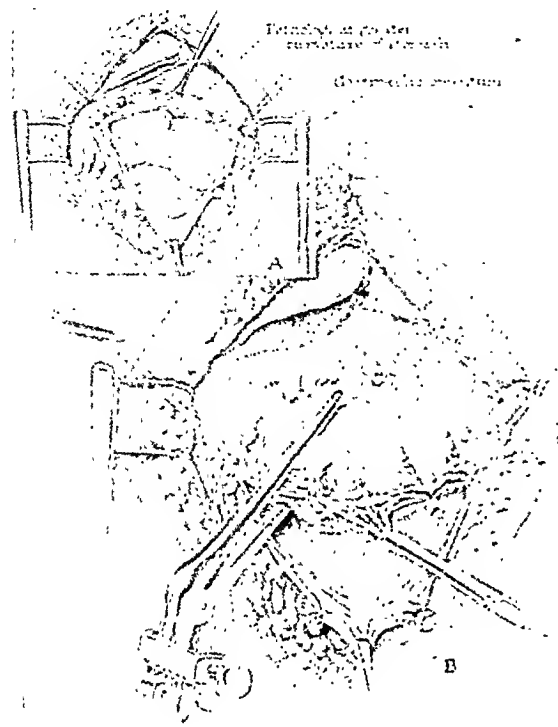


FIG. 3. A. Gastrocolic omentum detached from stomach to be resected. Guy stitches placed  $\frac{1}{2}$  in. on either side of ulcer and area of infiltration. These define line of resection. B. Left clamp grasping stomach at oblique angle with tip at point opposite center of ulcer. Clamp placed  $\frac{1}{2}$  in. away from guy stitch.

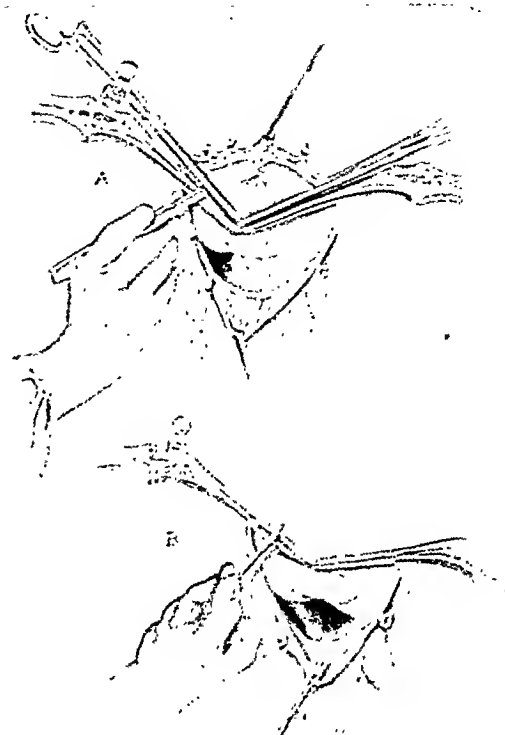


FIG. 4. A. Left and right clamps applied, grasping a v-shaped piece of stomach within which is found ulcer. Ordinary forceps placed to control the contents of stomach to be removed. B. Wedge-shaped piece of stomach removed. Tissues within clamps cauterized with phenol and alcohol. Clamps constructed to prevent slipping of tissues within blades.

FIGS. 3 and 4. Resection of ulcers on greater curvature.

evidence of trauma or diminution of the lumen.

Secondary hemorrhage as a result of the sloughing of the diaphragm has not occurred in any of the animals. There was no evidence of ulcer formation after sleeve resections or gastroenterostomy. Subsequent studies showed that the sutured ends heal firmly without granulation tissue, and without diminution of the lumen. The laboratory experiments conclusively prove that this method of gastrointestinal anastomosis is entirely satisfactory and that the special instrument used has many advantages over others utilizing the same principle. The instrument can

partial gastrectomy. It is of special value for resecting gastric and duodenal ulcers. This is a feature which has never been described nor is it possible with many of the other instruments that have been devised. The following is a more or less complete discussion in detail of the various types of anastomosis.

#### RESECTION OF ULCERS OF THE STOMACH

*Ulcers on the Greater Curvature:* The first step is to determine the extent of the ulcer and the area of infiltration. When this has been determined, guy stitches are placed  $\frac{1}{2}$  in. on either side of this area. These will define the limit of resection

of the stomach on the greater curvature. The right and left gastrocolic arteries are included in these stitches, or if that is not possible they are ligated separately. The gastrocolic omentum is now detached from the stomach between the two guy stitches. It is also a good plan to scrape away any omental fat for a distance of  $\frac{1}{2}$  in. from these stitches, so that when the edges are inverted there will be approximation of peritoneal surfaces without interposition of fat. Fat prevents fibrin formation, thereby delaying union, and is one of the causes of leakage (Fig. 3A). The clamps are now ready to be applied. It is desirable that a v-shaped piece of stomach be removed, with the ulcer area at the base of this angle. By so doing, the transverse diameter of the stomach is not altered when the two cut edges are sutured together. The v-shape is defined on both the anterior and posterior surfaces of the stomach, so that when it is removed and flattened out, the two v's form a diamond. The left clamp is applied about  $\frac{1}{8}$  in. from the left guy stitch at an oblique angle, with the tip of the blade at a point opposite the center of the ulcer (Fig. 3B). The right clamp is applied  $\frac{1}{8}$  in. from the right guy stitch, at about the same angle as the former. The two clamps will outline a v, with their tips forming the apex and the greater curvature the base. Ordinary forceps are now placed above the clamps, to control the contents of the stomach to be removed (Fig. 4A). With scalpel or cautery, the stomach is resected between the clamps and the forceps. Some authors believe that cutting should be done with cautery in order to prevent any possibility of hemorrhage from the mucous membrane, when the latter is not sutured. We do not believe that hot cauterization is absolutely necessary, since we have not had any of the animals bleed when the knife was used. This has also been the experience of other workers along this line. The incised stomach is carefully discarded so as not to contaminate the operative field, the surgeon, assistant, etc. Phenol

and alcohol are applied to the raw surface of the stomach protruding out of the clamps. Figure 4B shows how the edges

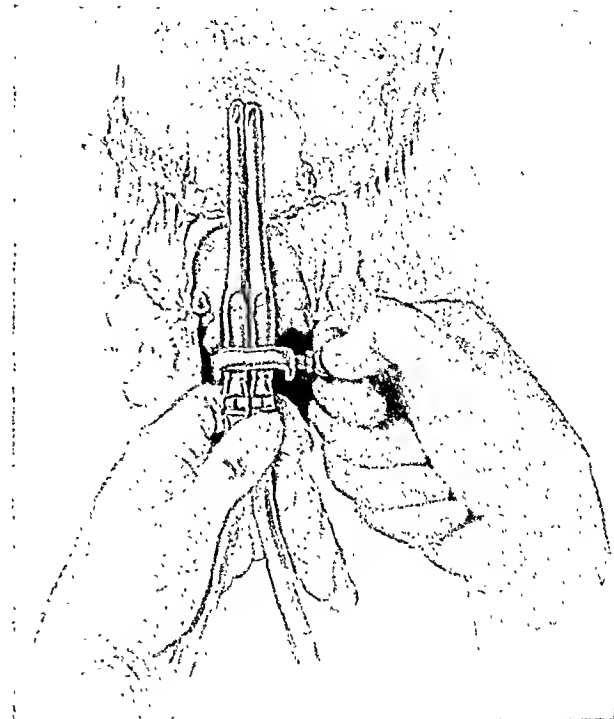


FIG. 5. Proper method of locking clamps. Left hand holds clamps together and screwed down with right.

of the stomach are securely held within the clamps, preventing any possibility of escape of the contents. The clamps are so constructed that no amount of pulling and handling will allow the stomach to slip out, unless a great deal of force is exerted, thereby tearing it out. After the edges have been cauterized, the two clamps are brought together and locked with the set-screw. Figure 5 demonstrates the method of locking the clamps. When the clamps have been fitted into each other, the operator holds them with his left hand and with the right he tightens them by screwing down the set-screw.

The stomach is now ready to be sutured. The suture material can be either silk, linen or gastrointestinal catgut. Our experiments show that gastrointestinal catgut is at times absorbed within forty-eight hours. This may be a little too soon and might cause trouble. We have found linen to be the best material for suturing the

intestine, and we prefer to use it, instead of silk or catgut for intestinal and stomach work. It is also a good plan to use a double

Lembert stitch is placed at the tip of the right clamp. This stitch does not include all of the coats, but just down to the

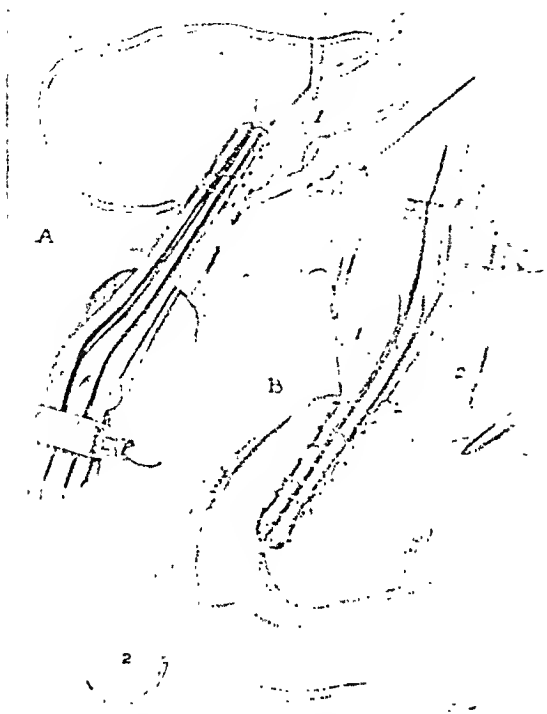


FIG. 6. A. Suturing anterior surface of stomach. Suture starts as Lembert stitch and continued with Cushing stitches. Ends as Lembert stitch on greater curvature close to left clamp. B. Instrument has been turned over exposing posterior surface of stomach. Shows 4 ends. (1) Short and needle end of anterior and (2) short and needle end of posterior sutures. Curved needle facilitates suturing posterior surface.

strand of suture instead of a single, because if one of the strands should break, there still will be one strand left to hold the anastomosis together. In our experimental work we used a single strand and never had any of the sutures break. Nevertheless, the criticism may arise that if it does break as the clamp is being removed, the whole principle of the method would be defeated. To overcome this we suggest the use of a double strand. We have also found that it is much easier to suture the posterior surface of the stomach with a curved needle, whereas on the anterior surface a straight needle can be used with ease.

The anterior surface of the stomach is sutured first. With a straight needle a



FIG. 7. A. Method of removing clamps. Blades have been released and as surgeon withdraws clamps assistant pulls on short end of anterior and needle end of posterior sutures. Operator pulls off sutures close to greater curvature when clamps are almost out. B. Direction in which assistant should pull on suture ends.

mucous membrane. It is continued as a Cushing stitch. These are placed parallel to and  $\frac{1}{8}$  in. from the clamps, first on one side, then on the other (Fig. 6A). It ends on the opposite side from where it was started, i.e., to the left of the left clamp on the greater curvature. The clamp is now turned over so that the posterior surface of the stomach is exposed. The assistant will now hold the clamps steadily, the operator suturing the posterior surface with a stitch similar to the one placed on the anterior surface. This begins as a Lembert stitch at the side opposite to where the anterior row ended and is continued as a Cushing stitch. It ends as a Lembert at the tip of the clamps (Fig. 6B). The clamps are now ready to be removed. This is one of the most important steps in the procedure and great care must be exercised by both the operator and the assistant. The assistant's duty will be to pull on the short end of the anterior and the long end of the posterior row of sutures. Figure 7A shows how the assistant holds and

pulls on these sutures, whereas Figure 7B demonstrates the direction of the pull, which is away from the elamps. The long end of the anterior and the short end of the posterior are grasped within a foreeps and are controlled by the surgeon. Both of these suture ends are on the greater curvature, whereas those held by the assistant are at the tip of the clamps. The operator releases the blades, and with the clamps in his right hand and the suture ends in his left hand, begins to draw them out. At the same time the assistant pulls on his suture ends. This must be done simultaneously and evenly so that the stomach edges will be inverted as the clamps are being pulled out. When the clamps are just about at the edge of the greater curvature, the surgeon begins to pull on his ends. When the clamps are completely out he draws on these so as to tighten both the anterior and posterior row of sutures. The ends are now tied, and a second row of Cushing stitches is inserted to reinforce the inner row. Since the needles that were used for the inner row did not penetrate the mucous membrane, they can be used for the second row (Fig. 8A, B). When the suturing is completed the gastrocolic omentum is re-attached to the greater curvature, either with interrupted or continuous stitches. With this method the diameter of the stomach is not altered, and it will be noticed that the line of suture will be transverse to the long axis of the stomach. There is also a shortening of the long axis of the stomach but not the transverse.

G. Gregory Connel<sup>16</sup> recently suggested fundusectomy as a new principle in the treatment of gastric and duodenal ulcers. He suggests this operation for the correction of secretory but not for motor abnormality, "such as persistent hypersecretion without organic stenosis as is often seen in duodenal ulcer or after surgical treatment, in jejunal or gastro-jejunal ulcer, and less frequently in gastric ulcer." He does not discuss the operative steps of the

operation but suggests a v-shaped or wedge-shaped excision of the greater curvature. This amounts to about the same

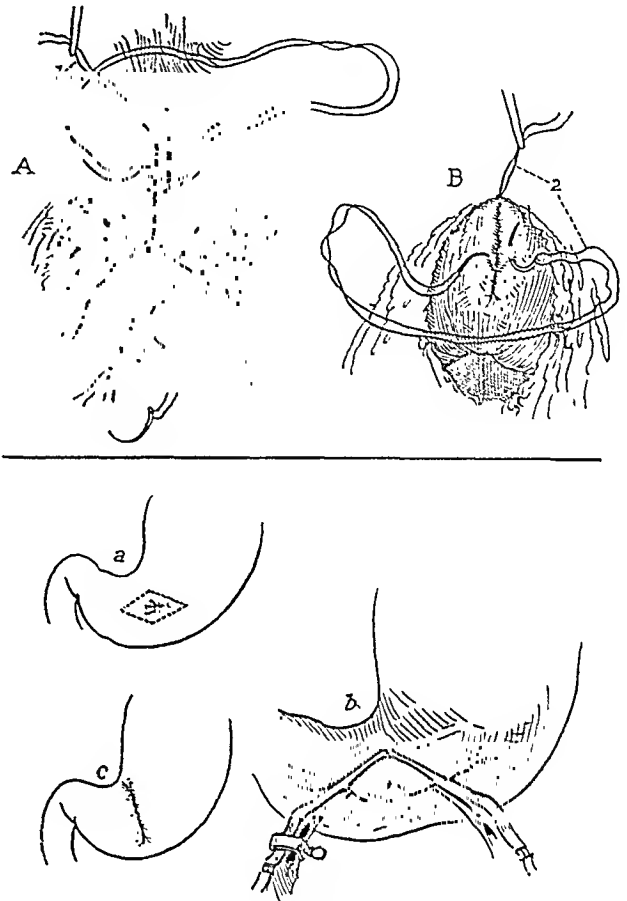


FIG. 8. A. Clamps have been completely withdrawn and ends tied. Second row of Cushing stitches to reinforce inner row. B. Placing second row of Cushing stitches on posterior surface. a, excision of ulcer on anterior surface of stomach. Ulcer area surrounded by imaginary diamond with axis in longitudinal direction of stomach. b, method of applying clamps; removing V-shaped piece. c, after completion of operation, line of suture in transverse diameter.

as a v-shaped resection of ulcers as described in this paper with the exception that the amount of greater curvature to be resected for fundusectomy would have to be much greater. The operation can be carried out without danger of peritonitis, it is easily performed and it requires about fifteen minutes to complete the entire work.

*Ulcers on the Anterior Surface:* Ulcers on the anterior surface of the stomach offer a somewhat different problem, although the principle is the same as in removing ulcers close to the greater curva-



ture. It is necessary in these cases to remove a diamond-shaped piece of stomach within which will be the ulcer (Fig. 8a). The long axis of the diamond should be parallel with the longitudinal axis of the stomach. When this is folded it will form a v or a triangular shape, with the long axis forming the base and the point of the clamps, when applied, the apex (Fig. 8b). At the base of the triangle will also be found the ulcer area. The first step in the operative procedure is to determine the ulcer area to be removed, and around this an imaginary diamond is defined. With Allis forceps, the stomach is grasped on the line formed by the two longest points of the diamond. By pulling on these the stomach will become folded so that when the clamps are applied, a v-shape can be outlined as demonstrated in Figure 8b. Forceps are then applied to control the contents of the stomach to be removed. The latter is resected and discarded and the raw surface protruding out of the clamps is cauterized. The clamps are brought together and locked. The same type of suture is used here as in resection of ulcers on the greater curvature. When the operation is complete, the suture line will be in the transverse diameter of the stomach (Fig. 8c), thereby increasing this diameter. To insure hemostasis any large vessel that leads into the clamps should be stick-tied.

*Resection of Duodenal Ulcers:* This method of resecting ulcers is applicable also for ulcers on the anterior surface of the duodenum. Because of the relationship of the pancreas to the posterior surface of the duodenum, surgery of this region is very difficult, if not impossible. As in resecting ulcers on the anterior surface of the stomach, a diamond shape piece of duodenum is folded with the long axis in the direction of the long axis of the duodenum. The clamps are applied in the same manner as described previously and the operation is completed in the same manner. Should the ulcer be located close to the pylorus, part of the sphincter can

be resected with the ulcer. The advantage of this method is that the duodenum will be enlarged at the point of anastomosis and greater enlargement can be secured by removing a greater portion of the duodenum.

*Resection of Ulcers on the Lesser Curvature:* The blood supply of the lesser curvature of the stomach is very profuse and for this reason it is important to ligate the right and left gastric arteries and their branches well away from the line of resection. The lesser omentum is detached from the lesser curvature in between the two guy stitches which are placed on the lesser curvature  $\frac{1}{2}$  in. away from the line of infiltration surrounding the ulcer. Again, a v shape portion of the stomach, within which will be the ulcer, is to be resected so that the transverse diameter will not be altered when the operation is completed. The clamps are applied, grasping a v shape piece of the anterior and posterior surfaces of the stomach. Forceps are placed to control the contents of the part to be removed. This is resected, carbolized and discarded. The clamps are brought together and locked. The anterior surface is sutured first, beginning with a Lembert and continued with Cushing stitches. It ends as a Lembert to the left of the left blade on the lesser curvature. The clamps are turned over exposing the posterior surface, and sutured in a manner similar to the one described. When the clamps are ready to be removed, the assistant should be instructed to pull upon the short end of the anterior and the long end of the posterior sutures directly away from the clamp. The surgeon controls the ends at the lesser curvature, but does not pull on them until the clamp is almost out. As the surgeon releases the blades and begins to draw out the clamps, the assistant pulls on his sutures. This must be done simultaneously in order to invert the edges of the stomach as the clamps are being pulled out. The operation is complete in the same fashion as described under Resection of the Ulcers on the Greater Curvature.

**Lateral Anastomosis:** The first thing to determine in this operation is the extent of the pathology. This is a very important part of the operation. It is far better to sacrifice 2 or 3 in. of healthy bowel rather than to anastomose gangrenous bowel. When this has been determined it is also a good plan to place stitches at the two limits of the resection to act as guides for excision. These stitches should be taken at the mesenteric border and include the muscular coats of the intestine. When tied they obliterate the mesenteric angle; they also shut off collateral circulation. In this manner a bloodless operation can be performed with minimum danger of spreading infection through the lymphatics of the mesentery. The arteries that supply the gangrenous bowel are ligated separately and the mesentery is incised. Forceps with longitudinal serrations (Carmalt) are applied at least  $\frac{1}{8}$  inch away from the mesenteric stitches, towards the diseased bowel. Forceps are also applied to control the contents of the gut to be removed (Fig. 9A). The diseased bowel is excised between the forceps and the edges protruding out of the Carmalt forceps are cauterized and inverted by the Kerr-Parker method (Fig. 9, B, C). When this has been accomplished the two loops of intestine are placed side by side and the clamps are applied. The left clamp is applied so that its tip points away from the blind end of one of the loops, whereas the tip of the right clamp points towards the blind end of the other bowel (Fig. 9D). Sufficient tissue is allowed to protrude out of the clamps so that when it is shaved off an opening will be made into each intestine. The amount of gut to grasp within the clamps will depend upon the size of anastomotic lumen desired. Grasping about  $2\frac{1}{2}$  in. will give an opening of about 2 in. which is sufficient lumen. After the clamps have been brought together and locked the same type of suture is used as described, and the completion of the operation is the same. The anterior row of suture is inserted first, beginning

at the tip of the right forceps with a Lembert stitch and continued as Cushing's (Fig. 9E). It ends at the opposite side as a

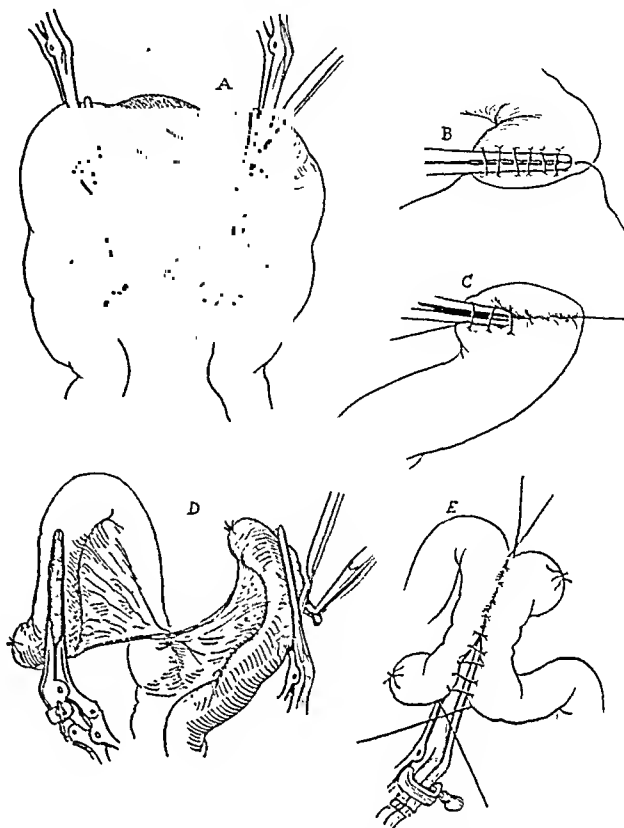


FIG. 9. Lateral Anastomosis. A. Special clamps applied beyond gangrenous area. Ordinary forceps can be used for this purpose. Diseased bowel removed under aseptic precautions. B and C. Two ends inverted by Kerr-Parker method. D. Left clamp applied so that tip points away from blind pouch, whereas tip of right clamp points towards blind pouch of other segment. Sufficient tissue protrudes out of clamps so that excised opening will be made into each segment of bowel. E. Both anterior and posterior sutures have been inserted. Blades released. Operator withdraws clamps simultaneously with pulling of short end of anterior and needle end of posterior sutures by assistant, so that stomach edges will invert as clamps are being withdrawn.

Lembert. The clamp is turned over and the posterior surface is sutured with the same type of stitch. When both surfaces have been sutured the long end of the posterior suture is delivered through the mesenteric space so that the assistant can pull on this and the short end of the anterior row. The clamps are released and pulled out, the same precautions being used as were described previously. The ends are tied and a second row of Cushing stitches is inserted.

The actual time consumed to perform a lateral anastomosis is about eight minutes with the use of the clamps. Time factor

prevents the formation of fibrin which is a necessary element in the process of healing. It delays healing and union and I believe it to be one of the most frequent causes of failure of this type of anastomosis, regardless, of whether it be the closed or open method.

Figure 10A shows the fat trimmed away from the bowel surface close to the line of incision. It also shows the method of applying the clamps. In order to insure sufficient blood supply to the edges, especially to that part opposite the mesenteric attachment, the clamps are applied in an oblique angle. The obliquity should always be away from the diseased bowel; otherwise there will be insufficient blood supply with the danger of gangrene formation and sloughing. It is also important when applying the clamps to allow the tips of the blades to extend just beyond the bowel edges and pointing towards the mesenteric attachment. Should the blades extend far beyond the edges of the bowel there is danger of separating the agglutinated septum when the clamps are being removed. After the gangrenous gut has been resected the clamps are brought together and locked. It is then sutured in the same manner as described for lateral anastomosis. Two rows of sutures should not be used for end-to-end anastomosis of the small intestine because of the danger of narrowing the lumen. However, interrupted mattress stitches can be inserted with safety. Figure 10B shows the method of delivering the needle end of the posterior row of suture through the rent in the mesentery. The assistant will pull on this and on the short end of the anterior suture as the clamps are being removed (Fig. 10C).

Although an end-to-end is the ideal physiological anastomosis, nevertheless I do not believe that it should be the method of choice. It has often been said that a chain is as strong as its weakest link and it certainly is true for this type of operation. It requires diligent attention to the minutest detail. A misstep leads to serious

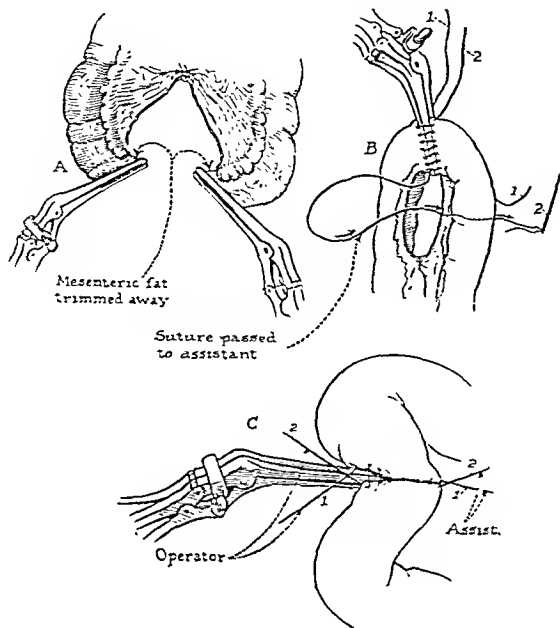


FIG. 10. End-to-end Anastomosis. A. Clamps applied with tips beyond mesenteric edges. Mesenteric fat trimmed away for short distance B. Both anterior and posterior surfaces have been sutured. Needle end, 2, delivered through mesenteric gap so that assistant, C, can pull on this and short end of anterior row on same plane.

in an operation is undoubtedly of importance, especially when it can be reduced to such proportions. This certainly is an advantage over the open methods of anastomosis, which require much more time. Another feature of this instrument is that the blind pouches can be made very small by applying the tips of the clamps close to the inverted ends.

#### END-TO-END ANASTOMOSIS

The method of ligating the collateral and central arteries, and the shutting off of the mesenteric angle are described under lateral anastomosis. A very important step in this operation is to free the mesentery from its attachment for a short distance from the line of resection. The purpose of this is to prevent the mesenteric fat from becoming inverted in the anastomosis. It is a well known fact that fat

if not fatal results. Our experimental results with end-to-end anastomosis have been very satisfactory. Only 1 dog developed a distemper after forty-eight hours. Because of his grave condition a laparotomy was made and it was found that the jejunum was dilated to the point of the anastomosis; beyond this the bowel was contracted. At the site of the anastomosis there was lodged a piece of wood the caliber of a lead pencil with great deal of debris around it. There was no evidence of peritonitis nor of any adhesions and the anastomosis itself was intact with no evidence of leakage. In this case the obstruction was evidently due to improper preoperative treatment of the animal. Because of the dangers attendant on the end-to-end method I believe that a lateral anastomosis should be the method of choice whenever it is possible to do so. The advantages are: (1) No danger from the inversion of fat, (2) complete peritonealization of the inverted edges, (3) the lumen can be made as large as desired, which eliminates the danger from stenosis, (4) greater blood supply, and (5) two rows of sutures can be inserted without encroaching on the lumen. The one bad feature of a lateral anastomosis is the formation of pouches. These as a rule do not cause any disturbance and usually disappear by the end of the third month after an operation. It has been our experience that a lateral anastomosis straightens itself within a period of three to six months.

#### SURGERY OF THE COLON

The peculiarities of the blood supply coupled with the highly septic contents of the large bowel mitigates against successful surgery of the colon. Undoubtedly, infection is the most serious complication in surgery of the colon and is associated with high mortality. In practically all of the open methods of colectomy there is a local peritonitis developed which must be overcome by the patient. Closed methods of colectomy abolish this factor and permit primary resections in many cases which

could not be possible with the open methods. Nevertheless, cases which require primary resection are few, and even though they are done under aseptic conditions it must not be forgotten that successful outcome can only be had after the proper preoperative preparation of the patient and an attempt made to determine the surgical risk involved. Should the risk be too great it is best to perform a two or three stage operation, in order to hold down the mortality rate. The Mikulicz principle of colectomy done in two or three stages, offers the lowest mortality rate comparable to one stage methods. Rankin suggested a modified Mikulicz for obstructive conditions of the colon, carrying out the principle of a closed aseptic method. The operation is divided into three or four stages. During the first stage the diseased bowel is removed and the remaining bowel is mobilized by suturing the peritoneum around it. The clamp is left on the bowel to control the contents and should the proximal loop become distended it can be opened by opening one side of the clamp. The bowel is prevented from retracting by leaving the other clamp closed on the other segment. It is best to wait from thirty-six to seventy-two hours before opening the proximal clamp, in order to allow the peritoneum to agglutinate around the bowel wall. After the clamp is entirely removed a spur will form which can be cut after about two weeks. This can be done by applying the clamps to crush the spur which will be cut by pressure necrosis. The operation is completed by closing the opening in the ordinary manner. The author's clamp can be used with greater ease in this operation, because when it is desired to allow drainage of the proximal loop the clamp can be entirely discarded.

In cases where a primary resection is indicated, a closed aseptic operation is undoubtedly the method of choice. The author offers an ideal aseptic and closed method possessing many advantages over the open methods. Figure 11B shows a

resection of the cecum and the ascending colon with an ilio-colostomy. The cecum and the ascending colon are freed of its

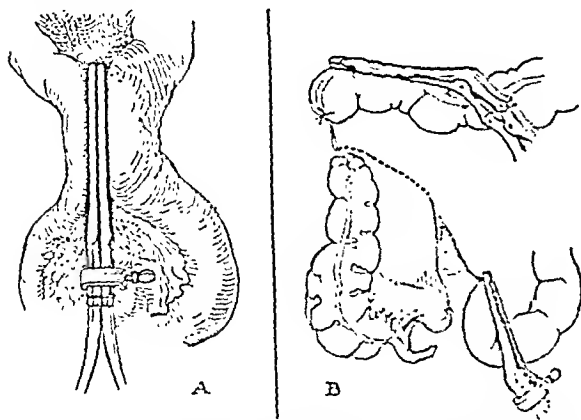


FIG. 11. A. Method of applying clamps for entero-enterostomy. B. Ilio-colostomy; end to side anastomosis of end of terminal ileum to side of transverse colon.

peritoneal attachment and mobilized in the usual manner. The ends of the bowel to be removed are either inverted or forceps can be left to control the contents. One of the clamps is applied on the end of the ileum at an oblique angle to insure sufficient blood supply. The other clamp is applied on the anterior longitudinal band of the colon. The tip of the clamp can be placed close to the inverted end, so as not to leave too big a pouch. The excess tissue protruding out of the clamp on the colon side is shaved off and clamps are brought together and locked. The rest of the maneuver is the same as described.

This procedure can also be followed for iliosigmoidostomy and ilio-colostomy of the transverse colon. The clamps can also be used for colocolostomy. To a large extent the anatomical relationship of the peritoneum to the bowel wall determines whether or not the latter operation can be done. In regions of the ascending and the descending colon the peritoneum limits the mobility of these segments so that a lateral anastomosis is almost an impossible operation; whereas, in the region of the transverse and the sigmoid a colocolostomy is a relatively simple operation, because of their mobility.

#### ENTERO-ENTEROSTOMY

This operation is at times indicated after an anterior gastroenterostomy or

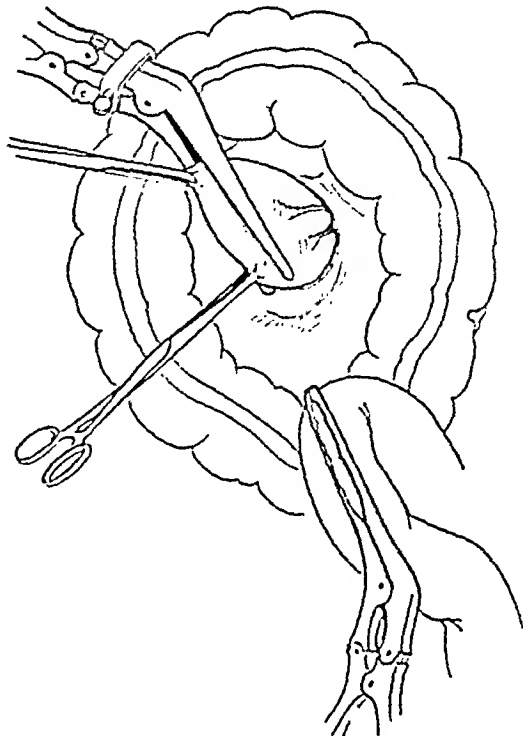


FIG. 12. Gastroenterostomy. Left clamp grasps posterior surface of stomach, with tip pointing towards lesser curvature. Right clamp applied on first loop of jejunum with tip at proximal end. When two clamps are brought together and sutured lesser curvature will be approximated to proximal end of jejunum; and vice versa for greater curvature.

after partial gastrectomy with a long posterior loop. The two loops of intestine to be anastomosed are placed side by side and clamps applied, about 3 in. of bowel being grasped. The protruding tissue is excised and clamps brought together and locked. The operation is completed in the same manner as a lateral anastomosis without danger of infection (Fig. 11A).

#### GASTROENTEROSTOMY

The clamps can be used for both an anterior or posterior gastroenterostomy. The clamps cannot be used with facility when the stomach is immobile, or when the mesocolon is too short thereby making it difficult to deliver the stomach through it. These cases offer a problem regardless

of the method, and at times an anterior operation has to be performed in preference to the posterior. In none of the animals did an ulcer form as a result of the use of the elamps. The crushing effect of the elamp is almost like a knife, the septum disappearing within forty-eight hours; hence it does not allow the gastric juices to act upon it. This is probably the reason why ulcers do not develop when this method is used in the human, as reported by Perret.

The technical principles for antiperistaltic posterior gastroenterostomy is as follows: An opening is made in the transverse mesocolon to the left of the midcolic artery. An Allis forceps is placed through the rent in the mesocolon and the stomach is grasped close to the lesser curvature at the angula incisura. With another forceps a corresponding point close to the greater curvature is grasped so that a line between the two forceps will correspond to the anatomical direction of the first loop of jejunum. The stomach is then delivered through the mesocolon by pulling on these forceps. Figure 12 shows the protrusion of the stomach through the mesocolon and the method of applying the clamps. The left elamp grasps the stomach held between the Allis forceps. The tip of the elamp points towards the lesser curvature. Sufficient stomach should protrude so that when it is cut the mucous membrane will be included. The other elamp is applied on the jejunum so that its tip points towards the proximal end. The protruding tissue is shaved and elamps locked. The operation is completed as described under lateral anastomosis.

For the iso-peristaltic method the incision through the mesocolon should be made, when practical, transversely, to allow greater access to the posterior surface of the stomach. Two Allis forceps are placed 1 in. from the greater curvature and 13 in. apart. To insure hemostasis, large vessels which lead into the line of incision are stick-tied. The left elamp grasps the stomach, with the tip of the blade pointing towards the cardiac end,

whereas the right elamp is applied on the jejunum with its tip pointing towards the proximal end. After the elamps are locked, the pyloric end of the stomach will be approximated to the proximal segment of the jejunum and the cardiac to the distal end. In this manner the jejunum will be parallel with the greater curvature and the peristalsis traveling in the same direction.

#### FINNEY'S PYLOROPLASTY

Whenever Finney's pyloroplasty is indicated the elamps can be used with much facility and without the danger attending the open method. This operation is essentially a lateral anastomosis of the first part of the duodenum to the anterior and greater curvature side of the stomach. At times the duodenum is bound down with adhesions and in such condition I do not believe that the operation should be attempted. This holds true not only with the elamp method but also with the open methods. At times the gastrohepatic ligament is short and has to be detached in order to mobilize the pyloric end of the stomach. This is a very dangerous procedure and should not be attempted unless absolutely necessary.

The technical point in this operation is first to approximate the first loop of the duodenum to the greater curvature of the stomach. The right elamp is applied on the stomach with its tip pointing towards the pylorus. The left elamp grasps the duodenum with its tip about 1 in. from the pyloric sphincter. The two blades should be placed at about the same distance from the sphincter. The operation is completed in same manner as in lateral anastomosis.

#### CHOLECYSTOGASTROSTOMY

I have also used the elamps on a man thirty-seven years old with carcinoma of the pancreas causing complete obstruction of the common duct. After the abdomen was opened the gall bladder was found markedly distended and enlarged.

The pancreas was enlarged through its entire extent and a small portion was removed for biopsy. The pathological report was adenocarcinoma of the pancreas. It was decided to do a cholecystogastrostomy with the use of the clamps. This was done after the gall bladder was partially evacuated with a needle and the syringe. The operative maneuvers are essentially the lateral anastomosis of the gall bladder to the stomach. The time consumed in this case was about eight minutes to perform anastomosis and there was no contamination or any spilling of the contents of the stomach or gall bladder. This patient made an uneventful recovery and at this writing (six months after the operation) he is working and free from symptoms.

#### CONCLUSION

1. The history of the development of gastrointestinal surgery clearly shows that the primary principles were well founded many, many years ago; however, we have yet to develop technical efficiency in order to eliminate peritonitis after an operation.

2. With the open methods of colectomy a local peritonitis develops in practically every case, whereas in surgery of the stomach and intestine it is followed in a small but definite percentage of cases. Aseptic procedures eliminate this factor

and reduce the operating time to a minimum.

3. Closed methods that have been suggested are not in vogue, or have been discarded, because: they disregarded surgical principles; were too complicated, or the instrument was too cumbersome, and did not carry out the purpose for which it was intended, thereby defeating the principle of a closed aseptic method.

4. The method described in this paper is an ideal closed, aseptic and quick method embodying the principles of gastrointestinal surgery. It commends itself because of its simplicity and ease of execution.

5. The clamps are mechanically perfected to carry out these principles. They are easily manipulated, simple in design and precise in action. They can be used in any type of gastrointestinal anastomosis; furthermore, with them, ulcers of the stomach and the duodenum can be resected.

6. Stenosis as a result of too large septum cannot be encountered with the use of this method, because of the crushing knife-like blades. Hemorrhage has not occurred in any of the animals; however, extra precautions must be taken regardless of the method used.

7. I offer this method to the surgical profession with a plea not to use it in the moribund cases, but more as a routine method for surgery for the gastrointestinal tract.

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[For Additional References see p. 34.]



# ALLERGY

## FOLLOWING RECTAL ADMINISTRATION OF QUININE-ALCOHOL-ETHER IN LABOR\*

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A GREAT many people say they cannot take quinine. When they are questioned more fully, they tell you that it gives them a fullness in the head and makes their head ring. True allergic symptoms, swelling, urticaria, fever and hemoglobinuria, are rare. Fletcher and Travers, who report a case of quinine idiosyncrasy that looked like a severe arsenical dermatitis, say that it was the only case of pronounced idiosyncrasy to quinine they had seen, and they had been in practice thirty-five and twenty years respectively in the Malay States where quinine is the established treatment for malaria. It is interesting to note that their patient could not take the levorotatory quinine, but could take cinchonine which is dextrorotatory.

In truly susceptible persons the smallest doses produce symptoms. Bell reports a case in which the toxic dose decreased with each attack. The fourth attack was caused by  $\frac{3}{8}$  grain. Fort's patient had rapid, difficult breathing, a sense of suffocation and weakness, swelling of face, hands and feet, and a generalized itching and burning after taking a single dose of  $\frac{1}{16}$  grain. On one occasion she had a local reaction on the lip following rubbing her lip with her fingers after filling some capsules with quinine. When a small child she often took quinine with no ill effect. Zacharias reports the case of a man who had an itching vesicular eruption on the inner side of the thighs, the scrotum and penis due to quinine in a contraceptive preparation used by his wife on one occasion. This patient had a similar rash on the scalp from using hair tonic containing quinine.

The symptoms may occur very quickly. Kirshnamurty's patient had violent sneez-

ing followed by distressing itching all over the body and an urticarial rash ten minutes after taking 5 grains of quinine. In one of the attacks in Fort's case the symptoms appeared within two hours. In her second attack an hour after taking a much advertised remedy for colds, she fainted and had the skin and respiratory symptoms as before. In her third attack the symptoms also appeared in an hour, this time after taking 15 drops of iron, quinine and sulphur elixir.

Boerner describes a skin test for the susceptibility of quinine and recommends a 10 per cent solution of quinine bisulphate as the best strength for the test. Mook recommends the skin test as an easy way to prove the susceptibility of persons to drugs. Edlavitch reports a case confirming Boerner's test. O'Malley and Richey report 2 cases confirmed by Boerner's test. They were able to completely desensitize one patient and to partially desensitize the other.

With the widespread and increasing use of the rectal administration of quinine-alcohol-ether for obstetrical analgesia, one would expect to encounter patients exhibiting untoward symptoms from the quinine, especially as some of the formulae contain as many as 20 to 30 grains of the drug. Two such cases have been reported. White reports the case of a primipara who was given rectal analgesia two hours before delivery. In four hours from the time of the injection she complained of an itching and burning all over the body. Her temperature had risen to 103°F. In six hours there was a pronounced erythema and a fine papular rash all over her body. The itching and burning were so intense that it was necessary to administer morphine. The condition lasted three days,

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when the symptoms gradually disappeared. A bran-like desquamation followed. Gustafson has recently reported a similar

She had pain on the first day. Her last menses began August 10 and lasted four days. Physical examination was negative except for a soft,

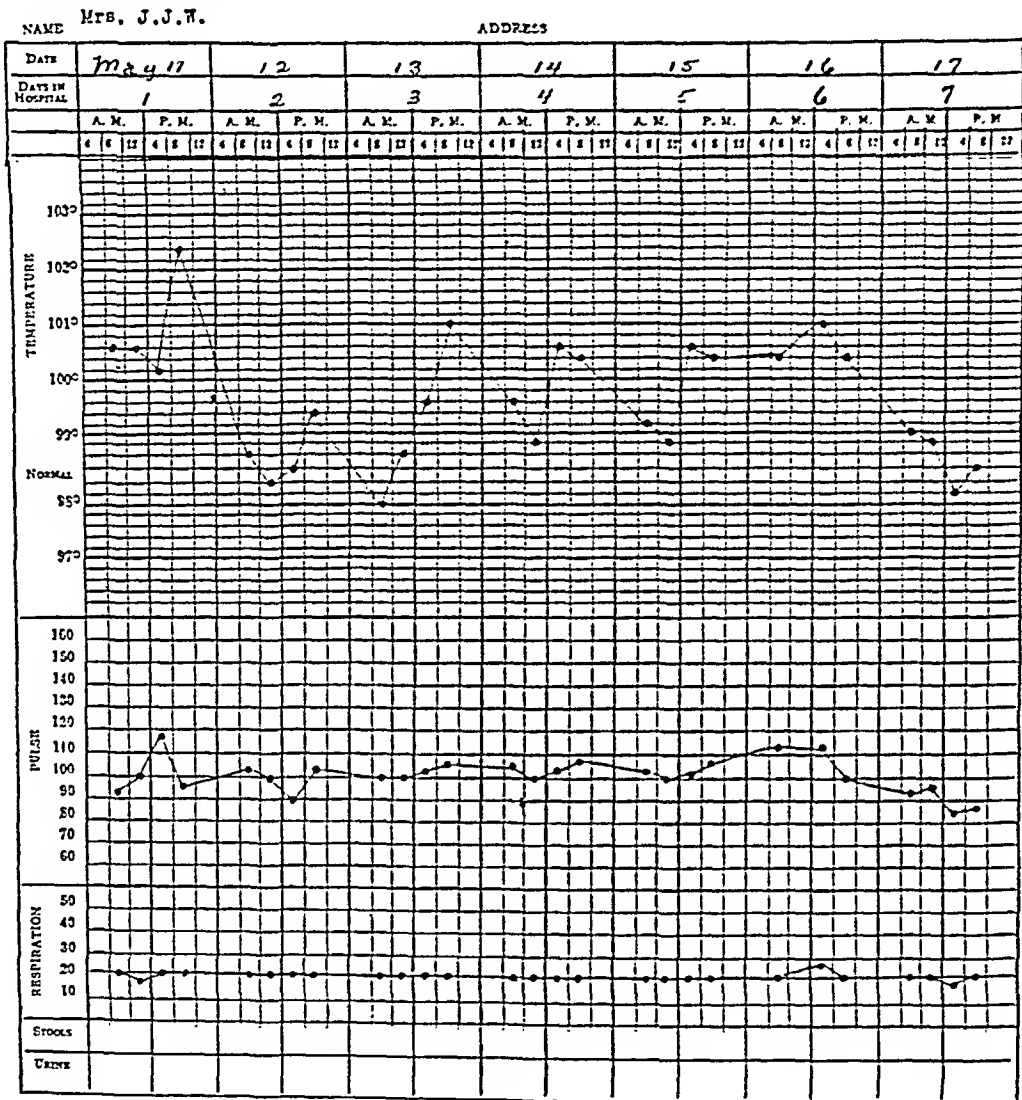


FIG. 1.

case occurring in a secundipara. The patient recognized the rash and itching as being the same that she always had whenever she took the smallest dose of quinine.

#### CASE REPORT

Mrs. J. J. W., a primigravida aged nineteen, consulted me September 22, 1928.

Family history and past history, as she gave them, were unimportant. Her menses began at sixteen years, were of the twenty-eight day type and usually lasted six days.

movable, retroverted uterus. Blood Wassermann test was negative. Pelvic measurements were: Sp.I. 22½; Cr.I. 27½; Troch. 30½; D.B. 18½; Ob.R. 22; Ob.L. 22; Circ. 84; Height from the symphysis to umbilicus 15; to ensiform 32; pubic arch 70°; Tuber ischii 8½; Ant. Sag. 6½; Post. Sag. 6½; Ant-post. 10; Depth of symphysis 5.

Her pregnancy was normal except for a mild attack of influenza in January. Her blood pressure ranged from 110/70 on her first visit to 130/85 on April 27, 1929. The urine was normal except for a slight trace of albumin on several occasions.

Labor was induced on May 11, 1929. A No. 5 Voorhees bag was placed at 1:12 P.M. She began to have pains at 3 P.M. The cervix was fully dilated at 11:30 P.M. and she was then delivered by version and extraction. The patient was given  $\frac{1}{6}$  grain of morphine and  $\frac{1}{200}$  grain of hyoscine before the bag was placed. The hyoscine, grains  $\frac{1}{200}$ , was repeated four times during the afternoon. When the cervix was one-half dilated, the patient was given 10 grains of quinine, 5ij alcohol, 5iiss ether and 5iiss olive oil per rectum. This was supplemented by inhalation of ether for the delivery. The baby, a girl, weighed 3232 gm. and was 51 cm. long. It cried lustily as soon as it was delivered.

When she was put back to bed, the patient's blood pressure was 130/90, respirations 22, temperature 99.2°F. and pulse 100. As she reacted she complained of burning and itching about her eyes, and the lids were seen to be a little swollen. The next morning the entire body was covered with a bright red rash, and the face was swollen. The rash persisted for five days during which time there was moderate fever. A catheterized specimen of the urine showed: specific gravity 1005, alkaline reaction, a trace of albumin, many red blood cells and an occasional leucocyte. Culture was negative. On May 17, the leucocytes were 10,800, polymorphonuclears 50 per cent and lymphocytes 50 per cent. Blood culture was negative. The subjective symptoms, itching and burning, were controlled with luminal and bicarbonate of soda. The patient sat up on the seventh day. When she left the hospital on the eighth day, she was in good condition except for a pronounced

desquamation. The baby's skin was free from eruption.

On June 8, 1929, the patient returned for a postpartum examination. She felt well and was giving plenty of milk for her baby, which weighed 3855 gm. She herself weighed 55.8 kilos, a gain of 3.5 kilos over her usual weight. Blood pressure was 125/80. There were still a few bran-like scales on the abdomen.

Patient returned Jan. 4, 1930, four and one-half months pregnant. I took this opportunity to give her a skin test, using a 10 per cent quinine bisulphate solution. I started the test at the beginning of her examination (11:30 A.M.). There was no reaction while she was in the office. At her second visit, however, she told me that at 4:30 P.M. the upper scratch, the one on which I put the quinine solution, began to burn and itch, and a red spot some 6 cm. in diameter appeared which lasted several days. Even now (Jan. 24) a scaly discoloration is distinctly visible.

#### COMMENT

Idiosyncrasy to quinine administered per rectum must be rare. Harrar reports the use of 20 grains in ether-alcohol-oil mixture in 5800 cases with no untoward results. In my own experience of 868 cases I have stuck to the 10 grains of the No. 3 formula of Gwathmey's original communication. While one case in 868 seems almost negligible statistically, yet the symptoms of quinine allergy are so extremely disagreeable that it would seem wise to add Boerner's to one's antepartum examination if one used rectal analgesia.

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# FRACTURES, CONTUSIONS, LACERATIONS

## AND THEIR RELATION TO DISABILITY\*

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MANY books and papers have been written on fractures. All contributors to our knowledge of fractures classify them as to their condition, predisposing factors and their causes. Given a definite case of a fracture, our duty is to restore the function of that bone and also the functions of the dependent soft tissues and remove or alleviate the discomfort or pain which the injury may be responsible for.

The treatment of these cases does not depend on the causes of the injuries, but on the nature of the fractures or injuries. Soft tissue injury plays a very important part both in the treatment as well as in the extent of the temporary total and permanent partial disability.

Skeletons, whether they are internal (like the human, etc.) or external (like the crustacean) serve at least four purposes:

1. They are the solid pivots of the movements assigned to the various animals.
2. They are the solid frames which serve to support the softer structures of the body.
3. They afford protection to many delicate parts of the body (in the human, to the eyes and the brain, and in some animals, to the whole body).
4. They have the capacity to manufacture some blood cells.

Injured bones are responsible for:

1. Impaired function of (a) the bone *per se* (b) the bone as a pivot.
2. Failing to act as a proper support for the soft tissues.
3. Failing to protect the soft parts (delicate parts) and by disarrangement press upon or injure the soft tissues, and
4. By their ability to form osteoblasts, regenerating new bone and reuniting the fragments.

While the results of traumatic surgery depend on the skill and experience of the surgeon, the disability (real or imaginary) depends more on the frame of mind of the patient, who is assured of a weekly compensation during his temporary disability and of an additional compensation for permanent disability (if any). In such cases the relation of patient to surgeon as well as the attitude of the patient to his disability is totally different from relations of patients having similar disabilities to private individuals, who are not compensated by employers or insurance companies. For these reasons the writer is of the opinion that a few remarks about the duties of a traumatic surgeon, the latter's qualifications and the problems of disability should prove useful to all those who are interested in this branch of surgery.

### THE DUTIES OF A TRAUMATIC SURGEON

1. To determine whether there was an injury. To give first aid and further treatment for the relief of pain and suffering and for the restoration of the fracture and the injured part to normal or as near as possible to normal. His first duties are purely professional in administering the treatment to the best of his ability.

2. His duties to the community require of him an unbiased observation and opinion as to whether the injury was accidental and the responsibility rests with the employer, or due to gross negligence or intoxication on the part of the employee, and therefore a menace to his fellow-workers; in the case of automobile accidents, a menace to pedestrians and fellow drivers. Injuries may also be secondary to some constitutional diseases, such as epilepsy, embolism, cerebral thrombosis, diabetes and bone diseases (sarcoma), etc. A careful history of

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the case is as important as in all other medical cases.

3. He is to be fair to all parties, employee and employer, the injured and the assured. The prosperity of a country depends upon its industries. While the benefit of the doubt should be given to the workman, one must not, however, allow the workman to believe that every finger that has been scratched (with no infection) is worth a big disability, or that a fractured rib, with no cough, no traumatic pleurisy, no blood, which heals in a few weeks leaves a permanent disability ranging to all sorts of percentages.

4. The sooner the patient receives proper aid, the better the results for the patient and the less the disability. Incidentally the expense is also less.

#### QUALIFICATIONS OF A TRAUMATIC SURGEON

1. He must be a general surgeon; he must be able to render first aid; but he must also know what he can do and what he cannot do.

2. He must be a competent surgeon, because the surgeon who can send his injured men back to work fit and really fit, in shortest possible time, will please some workmen, the majority of employers and all insurance companies.

3. He must understand men: and there are many types. You cannot treat even physically an Italian workman the same as one would a Swede. The same applies to many other types. He must be a diplomat, because employees are nearly always biased against company doctors, particularly in the estimation of disabilities.

4. He must be careful in every respect:

(a) He should keep careful notes,

(b) He should keep copies of every report,

(c) He must have a careful history of the injury,

(d) He must have a careful history of previous injuries,

(e) He must ever be ready to defend his honest diagnosis and opinions before the courts or commissioners,

(f) He must be able to say that he examined the whole patient, rather than the injured part only.

5. He must always be ready, in difficult cases, to share the responsibility with a confrere, whose ability he considers superior to his own:

(a) For the protection of the injured person,

(b) For the protection of the employer or insurance company,

(c) For his own protection.

6. He should be familiar with the rules and regulations of the workman's compensation commission and should understand jurisprudence.

7. He should be properly equipped to be able to handle any kind of emergency. He should understand physiotherapy.

8. He should be prompt in reporting injuries to the employer, insurance companies or other interested parties. The reports should be complete, showing details and full particulars right from the start.

#### DISABILITY

Disability may be defined as the inability of a workman to carry on with his usual work temporarily, permanently, totally or partially. This means that we have several kinds of disability:

Temporary total,  
Temporary partial,  
Permanent total,  
Permanent partial.

There is a fifth type, which is essentially not a disability, but rather a disfigurement, which may be responsible for the individual's decreased possibilities of obtaining work and may be classed as a cosmetic disability.

(a) Temporary total disability is the physical condition of an injured person immediately after the accident, which condition prevents the patient from carrying on with his usual work for a presumed period of time which is of a temporary nature.

(b) Permanent total disability is the

physical condition of an injured person, which condition prevents the patient from resuming his usual work permanently. At

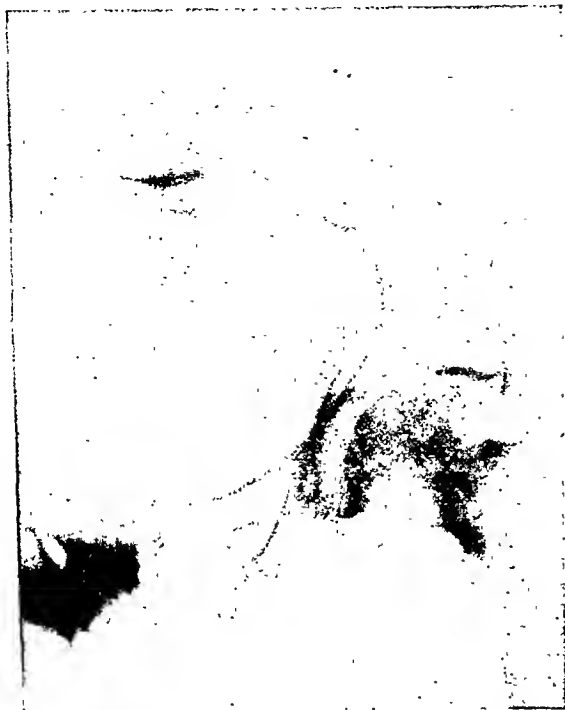


FIG. 1. A. R. male, aged thirty-two, laborer. Multiple fracture of right side of pelvis into acetabulum. Stellate fracture of acetabulum. Four weeks after injury plate was taken. Patient walked up two flights of stairs with aid of a cane. Eight weeks after injury he resumed his usual work and was advised to report for reexamination in about four weeks. He reported without any complaints. He was not aware of severity of injury.

the same time he will be unable to do any other kind of work.

(c) Temporary partial disability is the physical condition of an injured person after an accident:

(i) Which prevents a patient from carrying on with one or more important duties of his usual work,

(ii) Which impairs the efficiency of his usual work,

(iii) Which is accompanied by some discomfort (such as tiring very easily, etc.) and the conditions are temporary in character.

(d) Permanent partial disability is the same physical condition as described in paragraph (c), but the condition is permanent in character.

(e) Cosmetic disability (if one may describe it as such) is a condition which affects in the majority of cases the female worker by disfiguring the exposed parts of the human body, such as the face, hands, etc. The conditions may be, as in other cases, temporary or permanent in character.

Disabilities which may appear immediately after the injuries are of a temporary total or temporary partial character, may eventually (due to infection or faulty technic) become permanent total or permanent partial disabilities.

#### ESTIMATION OF THE PROBABLE DURATION OF A DISABILITY

The most difficult task of a traumatic surgeon is the estimation of the probable duration of the temporary total disability. It taxes the surgeon's ingenuity more than the making of a diagnosis or the treatment of the condition. The difficulties are manifold:

1. No two injuries are identical, even if the x-ray examination would permit one to say so. A fractured bone, properly set, when healed, leaves no disability. Effusion of blood, subsequent adhesions, involvement of a joint with prolonged immobilization, shortening, and partial or total ankylosis of the small bones are responsible for some sort of a permanent disability. The prognosis will depend on the nature of the injury, whether near or into a joint, whether it is a leg or an arm, a hand or a foot and whether the treatment was precautionary immediately after the injury, as pointed out somewhere else.<sup>1</sup>

2. The surgeon is not always selected by the company. Many physicians of the old school still do not believe in traction or plaster casts; some still believe in prolonged immobilization. The majority of these cases get faulty union, fibrous or non-union. The prognosis then depends on the method of treatment and the personal element of the surgeon.

<sup>1</sup> Illievitz, A. B. The home treatment of fractures of the bones of the leg. *Canad. M. A. J.*, 17: 412-415, 1928.

3. Displacement of fragments does not necessarily mean permanent disability.

4. Many patients (even at the present time) refuse hospital treatment. In these cases there may not be any disability eventually, but the duration of the temporary disability is considerably prolonged. In minor injuries it is preferable to give ambulatory treatment. Confidence in using an injured limb is regained early. The writer allows his patients up very early. See Figure. 1, a case of fracture of the pelvis extending into the acetabulum. The day this plate was taken the patient walked up two flights of stairs only four weeks after the injury. The only support was an ordinary cane. Figure 2 shows a fracture of the shaft of the femur five weeks after the injury. The patient was up and about with crutches and no splint.

5. Prolonged immobilization prolongs the period of temporary total disability. It may be responsible for eventual permanent disability. The blame may fall either upon the patient, who does not return as he has been instructed to do for inspection, physiotherapy and massage, or upon the surgeon, who allows the splint to remain for a prolonged period without physiotherapy, etc.

6. Compensation is undoubtedly, directly or indirectly, partially responsible for some prolonged disabilities. Many claimants for, in reality, they cease to be patients, will abstain from using their injured limbs until some sort of settlement is reached between them and their employers. They (the patients), in my own practice, have shown a definite inhibitory response, voluntary in character, to active or passive movements of the various joints of the body. It is not surprising (when one feels that the workmen deserve the benefit of the doubt), that so many surgeons disagree on both the period of disability and the percentage of disability. Rules and laws with standards of disability and schedules are seldom fair. Many patients with fractured skulls, after a short period of temporary disability,

have no permanent disability, while an injured cuneiform of the foot, or an injury to a small bone of the wrist, not properly

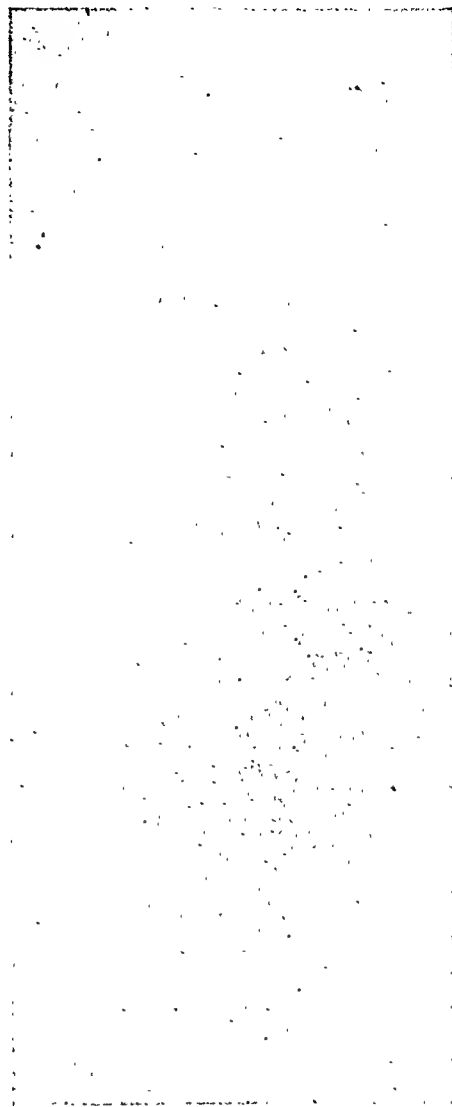


FIG. 2. C. T. male, aged thirty-five, shipper. Fracture of right femur, 1914. Femur was plated. He remained in the hospital for seven months. When seen in 1919 he had angulation of femur to extent of 80°. On May 20, 1930, he refractured the same femur. The plate was taken five weeks after injury, while patient was up and about, using crutches for protection, but no splint of any kind. On July 20, examination shows firm union and patient returned to his usual work.

treated, may leave a high permanent disability.

7. Injuries with infection, as contrasted with clean injuries, have a very wide range of disability. There may be no permanent disability, but the temporary total is often a very prolonged one.

8. It is difficult to prognosticate in a

case with subsequent osteomyelitis, yet there may be no permanent disability.

9. After a fracture has been properly set, the swelling disappeared, extravasated blood absorbed and the union of the fragments firm and in good position, a patient may still complain of pain in a wrist, knee, ankle and more often in a shoulder joint. The x-ray examination may corroborate firm union with no pathological condition in the joint. The surgeon finds that he has very little to offer in the way of treatment, for there are no limitations of the movements of the joint, no shortening; there is neither localized pain nor tenderness and the measurements are normal. The pain complained of usually disappears on working, (a very effective therapeutic agent). Light work for a week will usually do more good than any kind of treatment.

10. Cooperation of employee and employer, as well as of the insurance company, is very important. In this respect self-insurers are in a better position to get the injured workman back to his job earlier than in the case of insurance companies. The self-insurer is more prone to allow the injured men light work and thereby considerably aids the surgeon in his treatment. An employer who carries insurance is far more strict in exacting a full day's work from a convalescent patient. The workman is usually not very anxious to return to work, particularly if in addition to his compensation he also carries private insurance.

Table 1 shows various disabilities as observed in the writer's private cases as well as in public cases under his care at the Woman's General Hospital, Montreal. The chart is divided into 14 columns.

Column 1 represents the temporary total disability of simple fractures with little or no displacement.

Column 2 represents the additional temporary partial disability, but patient may be allowed to carry on with light work.

Columns 3 and 4 show the minimum and maximum percentage of permanent disability. The minimum in all cases is nil.

The maximum is small, ranging from 5 to 10 per cent.

Columns 5, 6, 7 and 8 show the corresponding disabilities as in columns 1, 2, 3 and 4, but in these cases the fractures were originally with displacement, overlapping or depressions, and consequently soft tissue injury is taken into consideration to a greater extent.

Columns 9 and 10 deal with foreigners (mainly Italian, Polish, Austrian and Russian), a type that usually exaggerates the disability. The disabilities of columns 1 and 2 are multiplied by the numbers of columns 9 and 10 respectively. Undoubtedly, there are exceptions. Such foreigners are a great problem to the traumatic surgeon. Many times one detects their bluff. Many times it is very difficult to do so. In the attempt to feign disability, they assume certain positions; these positions they try to retain for a long period. In time, these very feigned positions are directly or indirectly responsible for new disabilities, which are attributed to the original injury. In contrast with these the Dane, Swede and German usually cooperate with the surgeon for the early restoration of function of an injured part. Their pains as well as their actual disability are rarely exaggerated.

Columns 11, 12 and 13 represent the average man's attitude towards injury. Column 11 is similar to column 1 and represents injured men without any kind of compensation. Column 12 represents the average injured workman who can claim workman's compensation privileges. It is usually equal to the disabilities of column 1 multiplied by the numbers of column 12. Column 13 represents the workmen who not only receive workman's compensation but also carry private insurance. The workmen under this group are at times receiving more compensation than their actual income per week while at work.

Table 11 shows the number of fractures treated. It will be noted that although the actual number of fractures of the various bones is comparatively small and the total

TABLE I  
FRACTURES, CONTUSIONS, LACERATIONS AND THEIR RELATION TO DISABILITY

Simple Fractures	Without Displacement				With Displacement				Foreigners		Insurance			Remarks
	Temporary		Permanent		Temporary		Permanent		Temp. × by Per Cent	Perm. Per Cent	None	Comp.	Comp. and Priv.	
	Total	Part	Min. Per Cent	Max. Per Cent	Total	Part	Min. Per Cent	Max. Per Cent						
Column No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Skull.....	4 wks.	2 wks.	nil	?	4-5 wks.	2-8	nil	100	2	?	as 1	× 1.5	× 2	Complaints un- reliable.
Clavicle.....	6 wks.	nil	nil	5	6 wks.	2-4	nil	5	2	× 5	as 1	2	2.5	Plus nerve dis- ability.
Humerus.....	6 wks.	2 nil	nil	10	8 wks.	4-6	nil	15	3	× 4	as 1	2	3.	
Humerus an. neck.....	6 wks.	2-6	nil	10	8 wks.	2-6	nil	25	3	× 2	as 1	2	3	Marked varia- tions. Pleurisy?
Humerus sur. neck.....	6 wks.	2	nil	10	8 wks.	2-4	nil	15	3	× 4	as 1	2	3	
Rad. and ulna.....	5-6 wks.	0	nil	0	4-6 wks.	1-2	nil	10	4	× 5	as 1	1.5	2	Marked varia- tions. Pleurisy?
Coles.....	4-5 wks.	1	nil	0	5-7 wks.	2-3	nil	10	2	× 3	as 1	1.5	3	
Phalanges.....	6 wks.	0	nil	0	6-8 wks.	2-4	nil	5	4	× 5	as 1	3	3	Marked varia- tions. Pleurisy?
Metacarpals.....	6 wks.	0	nil	0	6-8 wks.	2-4	nil	5	5	× 3	as 1	2	3	
Wrist bones.....	4-6 wks.	0	nil	0	6 wks.	1-2	nil	15	2	× 2	as 1	2	2.5	Col. 5 with op- eration.
Ribs 1 or 2.....	3-4 wks.	0	nil	0	4-6 wks.	0	nil	0	3	= 25	as 1	2	3	
Pelvis.....	6 wks.	2	nil	0	8 wks.	2	nil	5	4	× 10	as 1	3	4	Col. 5 with op- eration.
Manubrium.....	4 wks.	0	nil	0	6-8 wks.	0	nil	0	3	= 25	as 1	2	4	
Femur.....	7 wks.	2	nil	0	8-12 wks.	4	nil	10	4	× 5	as 1	2	2.5	Col. 5 with op- eration.
Femur an. neck.....	5 wks.	2-6	nil	5	7-8 wks.	2	nil	10	4	× 4	as 1	2	3	
Femur surg. neck.....	5 wks.	2-4	nil	0	8-9 wks.	2	nil	10	3	× 4	as 1	2	2.5	Col. 5 with op- eration.
Tibia.....	3-4 wks.	1-4	nil	0	5-7 wks.	1-2	nil	0	4	= 25	as 1	2	2	
Tibia fibula.....	5-6 wks.	0	nil	0	5-8 wks.	2-3	nil	5	4	× 6	as 1	3	5	Col. 5 with op- eration.
Tibia ankle.....	3-4 wks.	1-2	nil	0	4-8 wks.	0	nil	5	3	× 3	as 1	2	2.5	
Os calcis.....	6-7 wks.	0	nil	0	8-12 wks.	2	nil	5	5	× 5	as 1	2	3	Col. 5 with op- eration.
Metatarsals.....	6-8 wks.	2-4	nil	0	8-16 wks.	2-4	nil	5	5	× 4	as 1	2	3	
Patella.....	6-8 wks.	2-4	nil	0	8-10 wks.	2-4	nil	5	5	× 5	as 1	3	3.5	Col. 5 with op- eration.
Spine.....	8-12 wks.	6-8	nil	25	16-26 wks.	6-8	10	75	3	× 2	as 1	3	4	



TABLE II

Fracture	Number	Discharged		Age
		No Dis-ability	Dis-ability	
Skull.....	11	10	1 (died)	25-59
Clavicle.....	8	8	0	19-47
Humerus.....	14	14	0	22-62
Radius and ulna..	15	14	1	17-55
Coles.....	12	10	2	18-51
Phalanges.....	16	16	0	18-60
Metacarpals.....	10	8	2	19-57
Wrist bones.....	7	7	0	26-39
Ribs.....	19	19	0	32-62
Pelvis.....	12	11	1	14-83
Manubrium.....	3	3	0	26-34
Femur.....	22	17	5	35-80
Neck.....	27	24	2 (1 died)	46-87
Tibia.....	9	9	0	14-53
Tibia and fibula..	16	14	2	14-58
Ankle.....	39	35	4	14-55
Os calcis.....	7	7	0	35-51
Metatarsals....	27	26	1	28-71
Patella.....	11	11	0	36-56
Spine.....	6	4	2	26-65
	291	267	24	

number of fractures treated was 291, the total number discharged with no permanent partial disability was 267, approximately 92 per cent. Two patients died within the first few days, having a fracture of the cranium, aged fifty-six. The other, aged seventy-nine, had a fracture of the neck of the femur. The disabilities in the remaining 22 cases are directly due to errors in treatment. Either surgical aid was first received weeks after the injury or they remained in plaster casts for a period of time without physiotherapy. In the case of one patient, when first seen, the foot

was deeply cyanosed, was in a plaster cast, which was for twenty-eight days without inspection. This man was treated for fractures of the first, second and third metatarsals, with no displacement, but he was left with a definite disability amounting to 10 per cent.

#### SUMMARY

1. Early repair of skeletal and soft tissue injuries depends on early partial use of the adjacent joints and the retention of the tone of the muscles during the short period of immobilization.

2. Prolonged immobilization prolongs the period of temporary total disability and often leaves a permanent partial disability.

3. A certain number of people are hypersensitive to their knowledge of the condition of the injury, rather than to the severity of injury proper. An individual with a knowledge of having broken a bone suffers and takes a longer time to gain confidence to use it, whereas the same individual with the same injury, but without the knowledge of the severity of the injury, actually suffers less and will attempt to use the injured limb at an earlier date.

4. Compensation and insurance have a definite tendency to prolong disability.

5. For the benefit of both assured and insured, it is important to start the injured man on light work as soon as possible, rather than to wait until the disability completely disappeared.



# DIVERTICULITIS OF THE COLON\*

WM. R. PARKES, PH.M., M.D., F.A.C.S.

EVANSTON, ILL.

THE subject of diverticulitis of the colon is one about which we are all too little familiar. The pathological condition occurs more commonly than is generally supposed and is being recognized much more frequently than formerly. Because I believe the knowledge of the facts regarding this disease is not widely enough disseminated throughout the profession, I take the liberty of quoting briefly from a few published reports, before citing cases of my own.

Rankin and Brown<sup>1</sup> estimate the incidence of diverticulosis as occurring in 1 per cent in 765,795 examinations and that diverticulitis occurs in 14 per cent of cases of diverticulosis. This would mean that one could expect to find a case of diverticulitis in every 1400 patients examined. Some observers think it occurs much more frequently.

A. B. Moore<sup>2</sup> found diverticulosis in 5 per cent of all x-ray examinations of the colon and states that it constitutes one-third of his roentgenological abnormalities of the colon.

At the Mayo Clinic where a great opportunity is afforded for study of intestinal pathology, diverticulitis is found to occur between the ages of twenty-seven and seventy-three,<sup>3</sup> the average age being fifty-three years, with the great majority of cases occurring in the sixth and seventh decades. Some observers claim that it occurs twice as often in males as in females.

Showing how much more commonly the disease is recognized than formerly, I would cite the report from the Mayo Clinic<sup>3,4</sup> of 215 cases over a period of sixteen years preceding 1923, and 1900 cases recognized in the four years following.

Diverticulitis should be distinguished from diverticulosis (a term suggested in 1914 by Case and others), the latter

comprising all cases of diverticula of the intestines without inflammation, and diverticulitis, those cases in which one or more of the diverticula has undergone inflammatory reaction.

Diverticulitis may be conveniently classified into

1. Simple diverticulitis, (self-limiting, either acute or chronic)
2. Complicated diverticulitis, Complication being
  - a. Abscess formation
  - b. Fistula
    1. External
    2. Internal {vesicocolic  
enterocolic}
    3. Multiple fistulae
  - c. Stenosis or obstruction
  - d. Associated with carcinoma, occasionally.

In the study of 27 cases by McGrath,<sup>5</sup> the pathological manifestations were as follows:

	Per Cent
Stenosis in.....	49
Ulceration in.....	40
Carcinoma in.....	25
Perforation in.....	22
Abscess formation in.....	14
Adhesions in.....	28
Fistulae in.....	9

In 42 cases that W. J. Mayo<sup>4</sup> resected for diverticulitis the location of the lesion was

In the sigmoid in.....	36
In the hepatic flexure in.....	1
In the transverse colon in.....	1
In the cecum in.....	1
In the rectum in.....	3

With such diversified pathology and variable location of the lesions one would not expect any specific train of symptoms or signs to identify the disease and this thought is borne out by further consideration of the aforementioned complicated

\* Submitted for publication May 31, 1930.

42 cases in which the clinical complaints were as follows:

Persistent abdominal distress.....	11
Intermittent distress.....	5
Colicky attacks.....	3
No apparent symptoms.....	2
Rectal tenesmus.....	2
Constipation.....	16
Alternating bowels.....	2
Diarrhea.....	1

As is self-evident, there is nothing in the way of symptoms to greatly help in clearing up this perplexing diagnostic problem.

Regarding treatment, in the 215 cases<sup>4</sup> previously mentioned occurring at the Mayo Clinic over a period of sixteen years, 112 were operated, bowel resection being done in 42, 103 being treated without operation.

Four cases, two males and two females, have been recognized by me during the past six months. Two proved amenable to medical treatment; two were not diagnosed until during operation or in the laboratory after operation. In both operated cases the presence of diverticula was known to exist but in neither case was this fact associated with the acute complicating conditions that led to the operations.

In the first one operated a diagnosis was made of ruptured appendix located in the pelvis. At operation an abscessed diverticulum of the sigmoid was found. Drainage sufficed to cure the patient.

The other case which I present in more detail gives the following history:

A married woman (Mrs. E. S.) aged fifty, having enjoyed good health for many years preceding this illness, began five weeks before her admission to the Evanston Hospital to have attacks of pain in her epigastrium and lower abdomen, this pain being rather persistent most of the time. She also had a fever of 99 to 101 during this period and was unusually constipated. She did not have nausea or vomiting. Her appetite was poor. An internist of very good repute, after a home examination, thought she had colitis and admitted her to a hospital where further examinations, including an x-ray study following a barium enema, were made. The x-ray study showed some small diverticula in the ascending and transverse

colon and a lack of filling in the upper part of the ascending colon. According to the patient's statement, her white blood count at that time was 7000. The internist arrived at a diagnosis of probable tuberculosis of the cecum. Possibly the low leucocyte count and the fact that the patient had been caring for a daughter with pulmonary tuberculosis influenced the doctor in this conclusion. He advised laparotomy, whereupon the patient decided to be transferred to the Evanston Hospital.

On admission there her temperature was 100.2, pulse 130, respiration 26, and white blood count 14,500.

Examination showed the abdomen to be the only location of evident pathology. Here no masses were felt. There was no evidence of free abdominal fluid. The right side of the abdomen was painful and tender on pressure, especially in the lower portion. There was also a sense of resistance imparted to the palpating fingers in the same location. Pelvic examination was negative.

The urine was negative. Examination of feces showed no blood. No further x-ray studies were thought advisable because of the apparent inflammatory condition. A tentative diagnosis was made of chronic abdominal inflammation and it was thought that a retrocecal appendicitis might explain all the symptoms and signs.

An exploratory operation was done on the third day after admission.

The appendix was found elongated, slightly congested and containing fecaliths. An appendectomy was done but as there was not sufficient pathology found in the region of the appendix to explain the clinical findings, further search was made. The cecum looked normal; there was no free abdominal fluid and no tubercles were recognized on the peritoneum. The peritoneum was slightly injected and more moist than normal. Search along the small intestine revealed no pathology. The pelvic organs likewise appeared normal. The ascending colon was examined and at the hepatic flexure a hard mass was felt, nearly the size of a tennis ball, apparently involving part if not all of the lumen of the colon at this point. This mass was hard and nodular and did not show any diverticula. The liver and gall bladder appeared normal. No enlarged lymphatic glands were palpated. The mass was considered to be malignant; at least this probability could not be eliminated. Specimen for biopsy was impracticable.

Immediate resection did not seem a safe procedure; therefore, the hepatic flexure was liberated so it could be lifted outside the

some of which contain grayish necrotic material, are noticed. Sections show considerable increase in fibrous tissue, edema, hemorrhage



FIG. 1. Filling-defect in ascending colon caused by inflammatory diverticular mass. Other scattered diverticula seen throughout colon.

abdomen. An ileocolostomy was performed between the ileum a few inches proximal to the cecal junction and the colon at a point about the middle of the transverse colon. The freed portion of the colon, including the tumor mass, was anchored outside the peritoneal cavity, somewhat like a Mikulicz operation, the plan being to do a resection later when the peritoneum became walled off. This second stage resection, an extraperitoneal operation, was done six days later, the bowel being severed by the actual cautery. An attempt was made to close the blind ends of the ileum and colon but the stitches later gave way and a fecal fistula resulted. Later by use of a clamp the division between the two open ends was broken down, leaving one opening, which procedure should facilitate the closure by sutures, if not spontaneously.

The specimen sent to the laboratory was reported on by Dr. Brandes in part as follows:

*Appendix:* Chronic inflammatory reaction.

*Section of colon:* This specimen consists of a portion of the large bowel measuring 15 cm. in length, showing a hard, more or less nodular area measuring about 5 × 8 cm. On cutting into the hardened area one sees a number of small diverticula. Other larger diverticula,

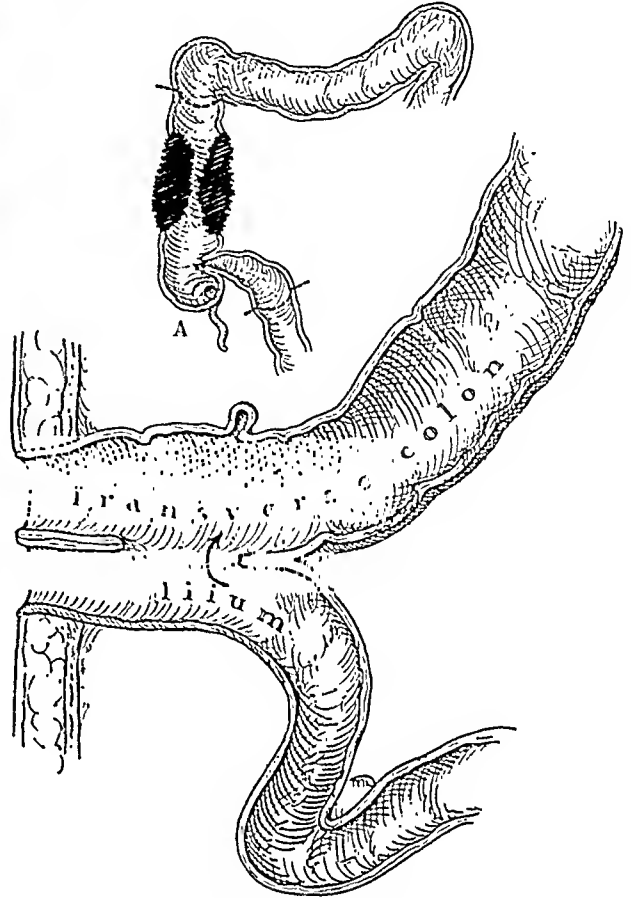


FIG. 2. On third day after admission, the first stage of a operation was done, at the same time that an anastomosis was made between ileum and transverse colon in such a way as to leave a bar of tissue between ileum and colon external to ileocolostomy opening. Terminal ileum and first part of colon bearing the tumor, as illustrated in inset, were eviscerated. Six days later division of tumor bearing bowel carried out at points indicated by dotted line in inset A. One of small isolated diverticula shown by x-ray illustrated in transverse colon.

and a rich infiltration with lymphocytes and large, round cells. There is no evidence of malignant change. There is no evidence of caseous necrosis characteristic of tuberculosis.

*Diagnosis:* Chronic inflammatory reaction with acute ulceration of multiple diverticula of colon.

This case furnished the usual experience of a difficult diagnosis in diverticulitis. The patient had abdominal pain, fever, leucocytosis, some right-sided rigidity, tenderness and constipation and was rather ill. No definite diagnosis was made other

than a chronic inflammatory condition. Exploration was done, and yet with the abdomen open and the living pathology

ulitis is self-limiting and is successfully treated medically. Case<sup>3</sup> outlines medical treatment as follows: Adoption of a

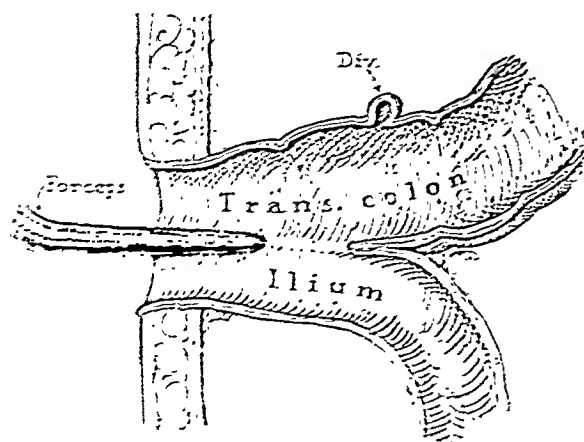


FIG. 3. Clamp crushing bar of tissue between ileum and colon.

before me it was impossible for me to determine whether we were dealing with a malignancy, with inflammatory ulceration or whether it was an entirely inflammatory affair producing a partial obstruction. Biopsy was impractical and the final diagnosis could not be made until after the second stage operation at which the specimen for the laboratory was procured for microscopic sections. In any case, resection seemed to offer the only means of cure. The adoption of the preliminary ileocolostomy and the modified Mikulicz resection proved safety measures which were justified by the results. The patient today, two months after operation, is getting about very comfortably.

#### SUMMARY

Diverticulitis is more common than is generally supposed. It should be kept in mind when considering obscure abdominal cases such as possible sigmoiditis, appendicitis, especially true transposed left-sided appendicitis, carcinoma, tuberculosis and some pelvic lesions. There are no characteristic symptoms known. Simple divertic-

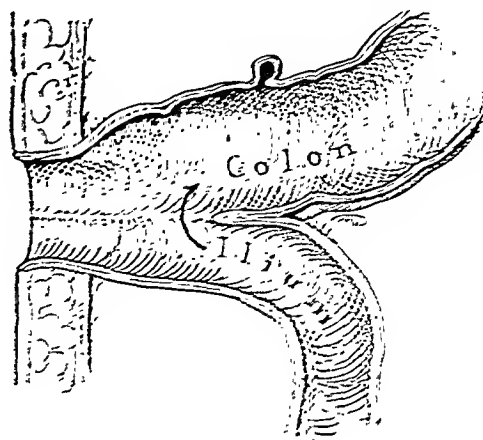


FIG. 4. Bar of tissue between ileum and colon external to ileocolostomy has dropped out, leaving free communication between ileum, colon and external abdominal wall. Fistulous openings on abdominal wall have contracted and are tending to close in. Closure by suture accomplished about ten weeks following colostomy.

"hygienic scheme, including careful attention to general habits, avoidance of overwork, regularity of meals, abundance of paraffine, a simple lactovegetarian diet, daily irrigation of bowels with saline solution, in some cases warm olive oil enemas, no purgatives, no rough foods," etc. If, in spite of such treatment, any of the aforementioned complications develop, such as abscess, perforation, fistula, obstruction or carcinoma, it will probably be necessary to resort to surgery, an appropriate measure being adopted to suit the individual case. Drainage alone often suffices in the abscess cases just as it does in appendiceal abscess. In case resection is required, the adoption of a two-stage procedure will often convert the very serious intra-abdominal condition into a comparatively safe extraperitoneal operation and thereby greatly reduce the mortality rate.

[For References see p. 96.]



# CLINICAL APPLICATION OF BLADDER TUMOR PATHOLOGY\*

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**T**HIS study was made upon 285 cases of vesical neoplasm submitted to biopsy or operation at the Mount Sinai Hospital since 1911. The classification employed is in accord with the general principles of tumor terminology and meets clinical requirements in that it takes cognizance of gross as well as microscopic criteria.

TABLE I

## THE COMMON VARIETIES OF VESICAL NEOPLASMS

i. Papilloma (benign)	cell uniformity and typism
Pedunculated	single
Sessile	multiple papillomatosis
ii. Papillary carcinoma	
Non-infiltrating	a. scattered areas of somewhat atypical cells
	b. more diffuse, more marked atypism
Infiltrating	c. cells of benign type (rare)
	d. cells anaplastic; stroma or stalk invasion
	e. cells anaplastic; submucosal or base invasion
	f. cells anaplastic; muscularis and perivesical invasion
iii. Non-papillary (flat) carcinoma	
	a. fibro (scirrhous)
	b. medullary (transitional cell)
	c. adeno
	d. squamous
	e. hornifying

There were two chief objects of the study, to evaluate the biopsy for diagnosis and to evaluate the pathology for prognosis.

The biopsy material is obtained with a rongeur forceps through the cystoscope. It is important to obtain material from different parts of the tumor and from various tumors when they are multiple. Tissue removed with the fulgurating electrode is unsatisfactory. The material must be studied with great care and attention

to details, and with a mental attitude of "guilty until proved innocent."

In 242 cases the biopsy diagnosis rendered was correct in all but 12, 95 per cent. In the review of these 12 cases, 7 were found to be true errors, which could have been avoided. Therefore the biopsy is potentially reliable in 97.5 per cent.

TABLE II

## PAPILLOMA BIOPSY REPORTS CONFIRMED, 90 CASES

No. of Tumors in Bladder	Confirmed by Early Cystoscopic Control	Confirmed by Operative Specimen	Confirmed by Cystoscopic Control (1 to 15 Years)	Confirmed by Late Letter Control	New Tumors or Recurrences Only 23 Per Cent
Single 56 cases.....	29	6	26	1	12
Multiple 25 cases.....	14	4	9		7
Papillomatosis 9 cases.....	1	5	5	2*	2

\* 1 autopsy 5 years after cure.

TABLE III

## SOURCES OF ERROR IN BIOPSY DIAGNOSIS

1. Insufficient material or improper material.
2. Rare cases of infiltrating tumors of benign cell type (ie).
3. Coexistence of benign and malignant growths in the same bladder.
4. Malignant cell changes confined to inaccessible depths of the tumor.
5. Papillomatosis cases.

It is of utmost importance that biopsy be made before resorting to the treatment of suspected malignancy because inflammatory lesions may simulate cancer closely. Failure to do this has led to harmful radical surgery.

Microscopic evidence of infiltration is found in 78 per cent of papillary carcinomas, whereas clinical signs of infiltration were observed in only 50 per cent. Resection should therefore include the full thickness of the bladder wall despite absence of gross infiltration, whenever the biopsy reports papillary carcinoma and

\* Read before the New York Pathological Society and the Section of Genito-Urinary Surgery, Stated Meeting, New York Academy of Medicine, March 6, 1930.

surgery is resorted to. Failure to do so has resulted in early recurrence.

In 182 cases the termination of the case is known or a follow-up of three years is available. Cases with negative cystoscopy and with no evidence of metastasis are considered arrested. The results appear in Tables iv and v.

TABLE IV  
END-RESULTS IN 182 BLADDER TUMOR PATIENTS

	Cases Followed	No. Arrested	Percentage Arrested
Papilloma	60	48	80
Papillary carcinoma, non-infiltrating	21	9	43
Infiltrating	71	13	18
Non-papillary carcinoma	30	5	16

TABLE V  
SUMMARY OF 285 CASES STUDIED

Type of Tumor No. of Cases	Biopsy Done	Biopsy Errors	No Treatment	Cystoscopic Trt.	Operative Trt.	Operative Trt. Plus Radium	Operative Deaths	Deaths Due to the Disease	Deaths Due to Other Causes	Benign Recurrence	Malignant Recurrence	Metastasis	No. Cases Followed	No. Cases Arrested	Percentage Arrested
Papillomas 91	190	0	1	71	23	1	3	4	22	1	160	48	180		
Papillary Ca. 138															
Non-infiltrating 30	35	3	5	9	11	5	3	5	4	1	2	21	9	43	
Infiltrating 108	84	7	20	13	63	24	9	35	7	2	15	11	71	13	18
Non-papillary Ca. 44	35	0	10	1	20	4	0	13	1		0	6	30	5	16
Cases No. 6, 7, 9, 10	4	2													
4 cases prostatic Ca.	4	0													

1 Myosarcoma. 1 Carcinoma in situ after operation elsewhere.  
1 Adenoma. 1 Fibroma.

Concerning prognosis, the following can be deduced: If cystologic criteria alone indicated prognosis, there should be a marked difference between group IIA and IIB, but the percentage of arrested cases was 44 and 42 respectively.

If bladder wall infiltration indicated prognosis, then group IIF and group III should show similar results, which is the result, namely 14 and 16 per cent.

Comparing non-infiltrating papillary carcinoma (groups IIA and b) with infiltrating papillary carcinoma (groups IIC, d, e, and f), the percentage of arrested cases is 43 and 18 respectively.

Papillomatosis cases are treacherous; of 13, 4 eventually proved malignant.

#### CONCLUSIONS

1. Reliable information as to the nature of bladder tumors is obtainable by cystoscopic biopsy in 97.5 per cent of cases. The unavoidable failures occur chiefly in multiple tumors and papillomatosis.

2. Prognosis cannot be made from biopsy material alone in cases of malignancy.

3. A biopsy diagnosis of malignancy in a case simulating papilloma by cytосcopy and response to fulguration is a signal for more radical therapy (radium or surgery).

4. Bladder tumors may be classified in a manner harmonious with general tumor terminology and with clinical requirements. They are benign or malignant.

5. Classification based upon cell grading alone is not as practical for clinical purposes, and prognosis on such basis does not coincide with the late results in this series.

6. The presence or absence of infiltration appears to be a more reliable guide to the gravity of the situation.

7. The site of the malignant tumor determines its resectability and thus influences prognosis materially.

8. If a biopsy diagnosis of carcinoma be made, and the case considered surgical, segmental resection of the whole thickness of the bladder wall is the procedure of choice. Failure to do so even in the pedunculated tumors has often resulted in recurrence. Stalk invasion and tumor cells in blood vessels at the base cannot be detected by gross inspection.

9. As only 30 of 138 papillary carcinomas showed no evidence of infiltration, it is probable that type IIA and b represent an earlier stage in the development of the disease. Although histological studies tempt one to believe that papillary carcinoma develops from papilloma in a considerable percentage of cases, the clinical evidence thereof is equivocal.

10. Before undertaking radical surgery for tumor of the bladder a biopsy should be made, as other lesions may resemble neoplasm very closely.

[For discussion of this paper see p. 73.]

# CONSIDERATION OF THE SURGICAL PROCEDURES IN THE TREATMENT OF MALIGNANT DISEASE OF THE URINARY BLADDER\*

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CONSIDERABLE uniformity of opinion exists regarding the treatment of small, single or multiple, more or less superficial malignant lesions of the urinary bladder. For the most part, such lesions have been, and are at the present time, successfully treated by transurethral electrocoagulation. Occasionally, however, there is failure of response to such treatment, and other therapeutic agencies, such as are applied to the larger and infiltrating lesions, must be resorted to. Inasmuch as there is little question regarding the methods of procedure in the group of cases in which lesions may be considered amenable to transurethral treatment, I wish to confine this paper chiefly to those lesions which fail to respond to such treatment, to those to which such methods are not applicable, and to those lesions which are more or less extensive and demand surgical consideration.

As yet there is still a justifiable conflict of opinion regarding the relative merit of the physical agents and surgical procedures in some of the extensive malignant lesions of the bladder. Probably in some instances the greatest prospects of cure, and of palliation in the truly inoperable lesions, may be expected through the combined use of both.

Ninety-five per cent of the malignant tumors of the bladder seen at The Mayo Clinic are epitheliomas. Broders' index of the degree of malignancy is a most important factor in determining results of treatment, and in the exercise of judgment as to the extensiveness of procedure that is justifiable. Malignant lesions of the bladder tend toward the higher degrees of malignancy. In a previously reviewed series of 480 graded epitheliomas, irrespective of their situation in the bladder, slightly more than half, approximately 58 per cent, of

the tumors were of malignancy graded 3 or 4. The situation of the tumor has some bearing on its degree of malignancy. Apparently there is a greater tendency for the development of highly malignant epitheliomas in the base of the bladder, than in the lateral walls and dome. In other words, in a series of 150 epitheliomas of the base of the bladder, the incidence of malignancy of grade 3 or 4 was slightly more than 64 per cent as opposed to an incidence of slightly more than 53 per cent of 214 epitheliomas of the lateral and posterior walls and dome. On the basis of the theory that in the lower degrees of malignancy the prognosis is better, everything else being equal, than in the higher grades of malignancy, it may justifiably be expected that the results of treatment of those lesions of the lateral walls and dome would be at least 10 per cent better than those of the base. Also, by virtue of their situation they are more readily excised. Experience has shown that some of the physical agents have been more effective in the treatment of the highly malignant lesions, because of their greater radiosensitivity, than in the treatment of lesions of lower grade. Other factors influence the results of treatment, however, not the least of which is the extent of involvement. The lesions of lower grade are often more or less superficial, whereas those of higher grade often infiltrate the entire thickness of the wall of the bladder and extend extravesically. Experience has shown that purely on the basis of the degree of malignancy one may be guided as to the justifiable magnitude of a contemplated surgical procedure, for with a given degree of involvement, the justifiable magnitude of surgical procedure is greater for the lesions of lower grade of malignancy than for those of higher grade. At the present time,

\* Read before the Genito-Urinary Section of the New York Academy of Medicine, March 6, 1930.



bearing in mind the optimism possessed by some regarding the results of treatment by physical agents, I am of the opinion that an operable malignant lesion of the bladder is a surgical lesion and is most successfully dealt with by surgical procedures. Difference of opinion exists regarding operability. Most tumors of the dome, lateral or posterior walls are operable, and may be removed by excision or segmental resection. Surgical procedures, curative in purpose, possess a justifiable risk, and a mortality directly in proportion to the relative prospect of cure. The preoperative knowledge of the degree of malignancy, as ascertained by examination of a specimen removed through the cystoscope, serves as a guide to the justifiable risk and magnitude of the operation, as opposed to the relative prospect of cure. In general, it may be stated that a surgical procedure is seldom justified that subjects the patient to a percentage of risk relatively higher than the relative percentage prospect of cure.

It may legitimately be asked: What are the prospects of cure of malignant lesions of the bladder? A definite prognosis for a malignant lesion anywhere in the body in the individual case is practically impossible to make, and prognosis may be made only in general on the basis of previous experience. Recently I reported the results obtained in the surgical treatment of 370 cases of graded epithelioma, in which all operations were done as procedures curative and not palliative in purpose. In brief, and in general, the results showed that irrespective of the size of situation of the lesion or the magnitude of the operation, 65 per cent of the patients on whom radical operations had been performed, for lesions graded 1 or 2, lived three or more years without recurrence; 34 per cent in whom the lesions were graded 3 or 4 lived three or more years without recurrence. When results were determined according to the site of the lesion, it was found that those following operations on the base of the bladder were not as good

as those for lesions in the lateral walls and dome. Actually the results showed that of patients with lesions of the lateral walls and dome nearly 50 per cent more survived the period of three years without recurrence than of those who had been operated on for lesions of the base.

#### SURGICAL PROCEDURES

It is an entirely legitimate question to ask: What may be done to improve the results from treatment of these lesions? Also, in what types of lesions may certain procedures be employed with the greatest prospect of cure? In a recent review of the surgical procedures employed during 1925 to 1929 inclusive, in 256 cases of malignant lesion of the bladder at The Mayo Clinic it was found that in 77 cases (30 per cent) the lesions were inoperable to any procedure that might be considered curative in purpose. This includes cases in which cystostomy was done as a palliative procedure and those cases in which inoperability was ascertained on exploration, but does not include patients whose condition was clinically hopeless and in whom not even palliative cystostomy seemed justifiable. It is noteworthy that in an additional 78 cases in which the condition was inoperable to the usual strictly surgical procedures of resection and excision, and the procedure of surgical diathermy, destruction by cautery and transplantation of the ureters and cystectomy were undertaken. A most conservative estimate places the inoperability or questionable operability in the neighborhood of 50 per cent; in other words, this estimate takes into account those patients who, by virtue of the extensiveness of the lesion if it is not entirely inoperable, may be treated, with a poor prognosis.

*Simple Segmental Resection and Excision:* Tumors of the lateral and posterior walls and dome of the bladder, by virtue of their situation, are most amenable to surgical excision and segmental resection and thus offer the best prognosis. Those lesions which are more or less superficial and are

confined to the mucous membrane, are readily excised, preferably by the cautery. The infiltrating lesions lend themselves to segmental resection, with removal of the entire thickness of the wall of the bladder. Even extensive infiltrating lesions of the posterior wall, with or without involvement of the intraperitoneal portion of the bladder, may be satisfactorily removed by thorough mobilization of the bladder, and the procedure may be transferred from a transperitoneal operation into an extraperitoneal one with little additional risk. It is not in the lesions in this situation, however, in which the serious problems of the treatment of tumors of the bladder are encountered.

*Operations on Tumors of the Base of the Bladder:* Occlusion of one or both ureters by tumors of the base of the bladder, or by their close proximity to the ureteral orifices, and disposition of the ureters, offer many obstacles to the successful treatment of tumors. A tumor of the trigone, of necessity, requires consideration of the ureters. Until recent years, tumors of the trigone, with involvement of one or the other ureteral orifice, have been considered, and properly so, next to inoperable. Of course, most extensive resections in the past have been done down to and including the internal sphincter, and at times including a part or all of the prostate gland, with a mortality rate which I believe for the most part has exceeded the percentage prospect of cure. Few such radical procedures are justified and they are rapidly being abandoned. An occasional tumor of the trigone may be successfully excised with the cutting cautery, including, in the male, part or all of the prostate gland, if the growth is small, even though infiltrating, and if it is sufficiently remote from the ureteral orifices so that they need not be encroached on in making such an excision. Young recently described a method whereby certain tumors of the base of the bladder may be removed, including the entire thickness of the wall of the bladder. Surgical diathermy in recent years has

accomplished much for tumors in just this situation and has resulted in freedom from recurrence for five years in a considerable number of cases in which the condition would have been entirely inoperable to the usual procedures which previously had been employed. Surgical diathermy has much to commend it for lesions that cannot be treated otherwise. Some degree of enthusiasm has carried the application to lesions which have been resectable.

Lesions surrounding, obstructing, involving or encroaching on one or the other ureteral orifice, or those in which the ureters are encroached on in the removal of the lesion require some disposition of the ureter in addition to eradication of the growth. Many such lesions may be hopefully removed by segmental resection, disposing of the ureter concerned by ligation or reimplantation into the bladder. My experience with these two methods of disposing of the ureter has been previously reported. Ascending infection presents the greatest hazard when reimplantation of the ureter is carried out, and in the series of cases at The Mayo Clinic, previously reported, the mortality of segmental resection and reimplantation of the ureter was 32 per cent, as opposed to the rate of slightly more than 13 per cent for segmental resection and ligation of the ureter. Even though the kidney, the ureter of which has been permanently ligated, may need to be subsequently drained or removed on account of hydronephrosis with infection, such procedures were necessary in but 10 per cent of the cases in the series studied at The Mayo Clinic. There is a fair percentage of tumors of the base of the bladder, involving but one ureter, in which segmental resection may be most satisfactorily accomplished, with legitimate and justifiable risk when the ureter is ligated rather than reimplanted. There is an occasional case in which the disease so extensively involves the bladder, and yet is definitely confined to the bladder, that nothing short of cystectomy can be considered.

It would seem that cystectomy should have a wide field of application. However, this is not as yet the case, for in only a few instances may conditions such as cystectomy be wisely considered. Usually, when the lesion is unsuitable for excision, resection, surgical diathermy or other physical agents, cystectomy is out of the question because of extravesical extension, remote metastasis, unilateral or bilateral partial or complete ureteral occlusion by the lesion, or the poor condition of the patient. The magnitude of cystectomy, with simultaneous or preliminary disposition of the ureters, is such that few patients with an extensive malignant growth of the bladder are suitable subjects for the procedure.

Cystectomy was first done by Baudenheuer, in 1887; the patient did not recover from the operation. Scheele, in 1923, reviewed 63 cases of cystectomy in which the mortality rate had been 40 per cent. The foreign literature contains many references to the operation, and isolated reports of cases. The work of Marion, Federoff, Lindström, Morton and others has been important in the development of methods of procedure. In recent years, Chute, Judd, Quinby, G. G. Smith and others, have emphasized the advisability of cystectomy in certain cases.

The disposition of the ureters has contributed greatly to the difficulties of the operation. Preliminary ureterostomy to the loin or inguinal region has facilitated subsequent cystectomy and has increased the safety of the operation, but it presents the disadvantage of absence of a urinary receptacle. A number of cases have been reported in which the ureters have been transplanted into the sigmoid or rectum, simultaneously with cystectomy, an operation which is accompanied by extremely high mortality. The introduction of ureteral catheters into the ureters, and bringing them out through the cystectomy wound, or to the surface of the skin, simultaneously with cystectomy, has been a hazardous procedure, because of ascending infection to the kidneys.

The perfection by C. H. Mayo and Coffey of methods of transplanting the ureters into the sigmoid has paved the way to the greater safety of cystectomy. The high mortality rate of transplantation of the ureters simultaneous with cystectomy does not justify its continuance as an operation in one stage. In the presence of malignant disease, transplantation of ureters is accompanied with greater risk than when the operation is done as one of necessity for such conditions as exstrophy of the bladder or irreparable vesicovaginal fistula; and simultaneous transplantation of both ureters is accompanied by greater risk than transplantation of one ureter at a time, with a minimum of two weeks between operations.

When conditions exist which justify cystectomy, I believe it may be accomplished most satisfactorily, but not without considerable risk, if the ureters are transplanted into the sigmoid, one at a time, preliminary to cystectomy, and if the bladder is removed several weeks later after good renal function and good urinary control have been established with the ureters in the sigmoid, thus confining the cystectomy entirely to an extraperitoneal operation. Such methods have been employed in the treatment of the following case.

#### REPORT OF CASE

A man, aged sixty-two years, came to the clinic April 29, 1929, on account of hematuria which first occurred in July, 1928; thereafter it had occurred intermittently. Two weeks previous to admission he had undergone a cystoscopic examination and a diagnosis had been made of carcinoma of the bladder.

Without entering into detail regarding the examination, I shall simply say that a cystoscopic examination was made May 2, and an ulcerating malignant lesion was found which involved the dome and left lateral wall of the bladder. A specimen was removed through the cystoscope and was reported to be epithelioma, graded 3. Exploration of the bladder was carried out May 7, at which time the growth was found to be more extensive than it appeared to be on cystoscopic examination; it involved

the entire left wall of the bladder, to the internal urethral orifice, and resection or use of surgical diathermy was considered inadvisable. The bladder was closed with the idea of consulting with the patient regarding the advisability of cystectomy.

May 24, through a right rectus incision, the right ureter was transplanted into the sigmoid by the method devised by C. H. Mayo and Dixon. Abdominal exploration did not disclose metastasis, and the bladder seemed to be in condition for subsequent removal. Three days after transplantation of the ureter, urine appeared in the rectum, and at the end of the tenth day the rectal output of urine from the right kidney was equivalent to that of the bladder from the left kidney, and the concentration of blood urea had fallen from 56 to 24 mg. for each 100 c.c., three days after the transplantation of the ureter.

June 18, about three and a half weeks after transplantation of the right ureter, the left ureter was transplanted into the sigmoid. Four days after this, the concentration of blood urea was 86 mg. for each 100 c.c. With restoration of the urinary output from the left kidney, gradual reduction occurred in retention of urea until two weeks after transplantation of the left ureter, when the concentration of blood urea was 32 mg. for each 100 c.c.

July 10, three weeks after the last transplantation, the entire bladder and part of the prostate gland were removed extraperitoneally. Extensive papillary squamous-cell epithelioma, graded 3, was found in the bladder. The growth appeared to be confined entirely to the bladder. Convalescence was satisfactory and complete recovery occurred.

#### COMMENT

Beer recently reviewed the subject of cystectomy, presenting the advantages

and disadvantages of the various methods of treating the ureters. Certainly the post-operative survival of 7 patients, reported by him, for from two months to as long as five years represents an accomplishment which to my knowledge has not been equaled by any other method of cystectomy, and simultaneous or previous disposition of the ureters.

Some disposition of the ureters must be made in contemplating cystectomy. Beer has demonstrated that life may be preserved when the ureters are implanted into the skin of the iliac regions at the time of cystectomy. A natural urinary receptacle is highly to be desired and may be obtained by transplanting the ureters into the sigmoid. Experience has shown that the mortality rate of transplantation of the ureters, simultaneously with cystectomy, is extremely high. It is high when the ureters are transplanted previous to the cystectomy, even though they are transplanted one at a time. Dilatation of the ureters, infection of the kidneys, and poor healing power, all are factors to be reckoned with in consideration of transplantation of the ureters in the presence of malignant disease of the bladder. I am of the opinion, however, that many of these difficulties may be obviated in the future and that the operation of transplantation of the ureters and subsequent cystectomy may have a constantly broadening field of application to include some of the earlier malignant lesions of the bladder instead of, as today, being confined to those lesions which are most extensive and are not amenable to any other form of treatment.

#### DISCUSSION OF PAPERS BY DRS. ASCHNER AND HUNT

JAMES EWING: The meeting this evening demonstrates the importance of joint meetings between pathologists and clinicians. One might say our clinical friends qualify for membership in the Pathological Society, first, at one extreme, owing to the very great detail and accuracy with which clinical judgments have been based upon thorough histopathological examinations, encouraging the pathologists to make these fine distinctions in the histological

study of tumors. And second, I think that the clinicians in this field deserve at least honorary membership in the Pathological Society for having furnished us so much autopsy material from unexpected sources and so many tumors of the bladder under conditions where we do not ordinarily obtain them. From both these points of view our clinical friends might qualify as pathologists, and I wish I could say as much for the pathologists. I do not think that many

pathologists are sufficiently acquainted with the clinical significance of some of the finer questions arising in the structure of bladder tumors to warrant being raised to the rank of genitourinary surgeon. I trust that the demonstrations made here this evening will encourage pathologists to learn more about the clinical aspects of the diseases they have to deal with.

I was particularly interested in Dr. Aschner's pathological classification and his minute discussion of the pathological features, and I am in accord with his general point of view. He recognizes the simple benign papilloma as a strictly benign tumor. In another tumor, which is grossly a strictly papillary tumor, there are peculiar groups of atypical cells and in these he finds that the clinical history very often indicates a malignant course, and therefore he calls this tumor a papillary carcinoma. I doubt if all papillomas showing these occasional groups of atypical cells run a malignant course, and I would prefer to class them simple papilloma, while noting the increased possibility of recurrence associated with these atypical cell groups. Then he has a type of papillary tumor which is definitely atypical throughout, but not necessarily infiltrating the base, which he also calls a papillary carcinoma. It seems to me that there is a marked difference between this group and the simple papilloma with atypical cell groups, and I would prefer to separate sharply between them, applying the term carcinoma only to the latter. Pathologists do not like to call a process cancer unless it shows definite histological criteria of carcinoma, such as markedly atypical cells, loss of polarity and heterotopia, which signs are missing in the simple papilloma with scanty groups of atypical cells. Then he has others more advanced, malignant and atypical throughout, and definitely infiltrating the stalk and the bladder wall. He makes a separate classification of all of these. Finally he has the flat carcinomas which are generally infiltrating. I think there is much practical advantage in making these distinctions, but whether there is any theoretical ground for separating them so minutely I am inclined to doubt. While I agree with him that tumors starting at one tempo do not often become transformed into more malignant tumors, in a group of 100 tumors of the bladder you will find many stages between benign papilloma up to malignant carcinoma, and in the individual cases it is often very difficult to satisfactorily apply

these special terms. I do not think it is wise to assume that carcinoma is something entirely different from a malignant papilloma. The two types of disease tend to run into each other, not that one case becomes transformed into the other, but that different cases cover all the gradations between one class and the other. The attempt to emphasize great differences between a solid carcinoma and a malignant papilloma is therefore strained. Nevertheless, it is most significant that by this very careful histological analysis of bladder tumors, which I believe has been carried out more particularly in Mt. Sinai Hospital than elsewhere, they have been able to show that the presence of these small groups of atypical cells in an otherwise benign papilloma carries with it an increased gravity in prognosis, and that is a significant thing for the pathologist. It encourages us to make more minute studies of histological preparations, and to express opinions regarding the clinical course of the disease which we are as a rule loath to make, because the prediction of the clinical course of any tumor from the histological section is always more or less hazardous. I do not know that there is any other field in tumor pathology where such significance may be attached to the histological structure. Possibly it is found in the larynx also. I have long since noted that the presence of a few atypical cells in a papilloma of the larynx generally signifies that the disease will recur and will kill the patient sooner or later. Pathologists may be encouraged to apply these criteria more carefully in other fields.

The question of histological grading has long interested me. I am in favor of histological grading carried as far as possible. While we have been grading tumors ever since the microscope has been used, the tendency to grade tumors more carefully has been increasing recently, owing to the work of Broders. I have little sympathy with those pathologists who because of lack of knowledge or intellectual laziness discard all this matter of grading tumors as of no value and unsound. As industry increases and experience enlarges, most of those men will gradually see that they are finding an opportunity to serve the clinicians which they should under all circumstances embrace. Therefore I am in favor of the effort to grade bladder tumors, and we have had some satisfaction in our institution in this attempt. As I understand, Broders included in his Group 1 of carcinomas of the bladder tumors which

most pathologists call benign papilloma. His Group 11 would probably fall in Dr. Aschner's class of papilloma with malignant cell groups. Therefore we can readily understand why Broders' classes, III and IV, are the most numerous among the bladder cancers and are the malignant ones. We have found that there is considerable difference in the outcome of these four classes, but when it comes to making fine distinctions between Groups III and IV, the true carcinomas, the clinical significance is perhaps not as great as it is in some other tumors, but it is still of value.

Another interesting point for the pathologist to keep in mind has been brought out by Dr. Hunt's remark that the malignancy of tumors in the bladder varies according to the location, the more malignant tumors being located in the trigone, and the less malignant ones at the fundus. This is also true of the tumors of the alimentary tract, which increase in malignancy from the anus to the lips. These tumors vary in malignancy depending on location. In our Head and Neck Service we are beginning to lay considerable stress on the location of a tumor, which in some instances seems to determine more or less the malignant course, even when it is of the same histological structure as tumors located elsewhere which prove to be more benign. This again is a lesson which the clinician teaches the pathologist.

EDWARD L. KEYES: I am not qualified to elucidate any further the differences in cellular malignancy. Though there have appeared certain minor differences in opinion, certainly we all today agree upon the important things, such as the use of the biopsy and the grading of tumors in one way or another. However, you will notice that there is great confusion in the fundamental use of the word malignancy. In both of the lists of statistics that we have had shown us, malignancy has been ultimately graded apparently in accord with the prospect of the death of the patient, as a result either of his tumor or of the treatment or lack of treatment which this tumor received. It is extremely difficult to disentangle these two items; the malignancy of the tumor itself and the malignancy of the surgeon who treats the tumor, or the lack of treatment that the tumor gets. Surely even a true bladder carcinoma may, if seen early enough, sometimes be controlled by relatively benign treatment. I have seen one such case, a real primarily infiltrating tumor of the bladder, which I

watched arise from beneath the mucosa and come through it. That tumor has been controlled for several years, after the implantation of some radium seeds through the cystoscope.

We should seriously push to the extreme limit in expert hands those methods of attack which are the least malignant themselves. It is because of the lack of malignancy of the supra-pubic operation for the implantation of radium that that method of approach has appealed enormously to me. I will not quote statistics. In my hands the implantation of radium suprapubically has given me an operative mortality of less than 10 per cent.

I have been greatly interested in the use of diathermy, which again is a non-malignant method of treatment as compared to the radical methods which he, like other surgeons, used to employ. There is a general tendency, I think, on the part of the surgeons to become less malignant. I believe it is along these lines that we shall progress, but we have a long way to go yet in weighing the advantage of cauterizing these tumors by the different physical agents, the electrocautery in contrast with radium. I favor radium. I am not prepared to state that I have any facts to prove that my favoritism is justified.

BENJAMIN S. BARRINGER: Rather than to directly discuss Dr. Hunt's paper, I believe it will to a certain extent fill out the picture to give the results of the treatment by radium of bladder cancers. Surgery and radium have long been contestants in the race for supremacy, and no one can say at present which will win. The comparison between radium results and surgical treatment is difficult because surgery picks the cases which are operable and discards the rest. At the Memorial Hospital we have subjected to radiation every patient with bladder cancer in which the cancer was believed to be confined to the bladder, no matter how large the tumor might be. Therefore in our series are included many inoperable cases. Sixty-three and one-half per cent of the tumors were involved or were adjacent to the trigone, including in the growth one or both ureters or the internal urethral orifice. Twenty-eight per cent of the tumors had bases of 6 square cm. (1 sq. in.) or less. In 72 per cent the bases of the tumor were greater than this, many of the tumors involving one-half or one-third of the bladder wall.

In the slides showing the result of radium implantation it is seen that the clinical diagno-



sis is often at variance with the pathological diagnosis. This is unavoidable, as we have to be content with a small portion of the tumor for the pathological examination. The clinical diagnosis is under these conditions more accurate than the pathological diagnosis. For example, a pathological diagnosis of a papilloma of a sloughing tumor has to be modified. A pathological diagnosis of papillary carcinoma of a tumor whose base is felt to be indurated and into whose base a radium-bearing needle makes way as though going through gristle likewise has to be modified. This is an infiltrating carcinoma.

In this first group of slides I show 62 cases of bladder carcinoma which have been graded by Dr. Ewing and Dr. Stewart, according to their malignancy and radiosensitivity. The diagnosis has been purely pathological and not clinical.

The second group of slides shows the results of treatment in 95 cases, divided according to the older classification into papillary and infiltrating cancer. The diagnosis has been entirely from the pathological side, leaving out of consideration the clinical diagnosis. The clinical diagnosis has at times been at variance with the pathological diagnosis. In these series no papillomas at all have been included. They have been rigidly excluded. All of these tumors have been epithelial tumors.

The first series of slides is a series of graded tumors. The number of cases is too small to be of much importance. The first is a papilloma with atypical cells, 14 cases. We controlled 8 cases, 57 per cent, and the uncontrolled number was 6 or 43 per cent. These are papilloma with atypical cells. The result of treatment shows that these tumors are real malignant tumors.

The second slide shows the papillary carcinoma Group 1, 40 per cent of which were controlled, and 60 per cent uncontrolled.

The third is the papillary carcinoma Group 11, of which 50 per cent were controlled and 50 per cent uncontrolled.

The fourth slide shows Grade III of the papillary carcinoma, and while it does not show in this table, it has been of a great deal of interest to me that when we get to Grade III the age of the patient begins to fall below fifty, which of course should always be a clue in the history as to the possible gradation of the tumor concerned. In these more malignant cases, and here again the number of cases is too small to

be of any real significance, the controlled cases are 37 and the uncontrolled 62 per cent.

Now we turn to the infiltrating carcinoma, Group 1, which includes 4 cases, but they show the drop in the controlled cases, 25 per cent against 75 per cent uncontrolled. One interesting case is that of a patient whom I have several times included in my control cases, and who went nine years and finally died of his infiltrating carcinoma.

The next table is infiltrating carcinoma, Grade II, 11 cases, controlled 27 per cent, and uncontrolled 73 per cent.

The next table is infiltrating cancer, Grade III, 4 cases, 50 per cent controlled and 50 per cent uncontrolled.

Again in this group of cases of Grade III malignancy the ages begin to fall below fifty, while in the other two groups there have been none below the age of fifty.

I want to point to the value of classifying the tumors according to their malignancy. It enables a more accurate comparison of results. That is what we are all after. When we wish to compare our results, if we have graded tumors, then I think we can more accurately compare them and know what each one is talking about. It determines the radiosensitivity of tumors, and therefore the proper dose of radium to be used. Radiosensitive tumors to be removed by operation or radium probably should be subjected to radiation by deep therapy before the operation. It also gives some idea of the prognosis of a tumor.

The second set of slides shows the results of treatment in 95 cases, divided according to the older classification into papillary and infiltrating carcinoma. The diagnosis has been entirely from the pathological side, leaving out of consideration the clinical diagnosis. There were 51 cases of papillary carcinoma, controlled 27 cases, 52.9 per cent; controlled over three years, 22 cases, 43 per cent; not controlled 47.1 per cent.

There were 44 cases of infiltrating carcinoma, controlled 19 cases, 43.1 per cent; controlled over three years, 14 cases, 31.8 per cent; not controlled 25 cases, 56.9 per cent.

The third set of slides shows the radium results in 125 cases in which the diagnosis was from the clinical side. This diagnosis has at times been at variance with the pathological diagnosis. There were 45 cases of papillary cancer; controlled 30 cases, 66 per cent; controlled

over three years, 25 cases, 55.5 per cent. Of 82 cases of infiltrating cancer, 30 cases were controlled, or 36.5 per cent controlled over three years, 23 cases, or 27.8 per cent, not controlled 52 cases, or 63.5 per cent.

Finally, let me stress the decided difference between the operative mortality when a tumor is removed by surgery and when it is implanted by radium. In 108 consecutive cases of suprapubic implantation of radium, 4 cases died in the hospital, an operative mortality of 3.7 per cent. This includes all cases, small and large, in which the tumor was thought to be confined to the bladder. In 62 per cent of these cases the tumor touched some part of the trigone, the ureters or internal urethral orifice. In those cases in which the tumor could have been removed surgically, and there were many in which it could not, the operative mortality would have been in the most competent hands from 15 to 20 per cent.

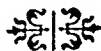
PAUL W. ASCHNER (closing): I hoped I had made myself clear. I do not like the term malignant papilloma, and I did not use it. It did not appear in any of the charts, and it was mentioned only as one of the great sources of confusion. We diagnose cases as papilloma; as papillary carcinoma, non-infiltrating; as papillary carcinoma infiltrating; and as non-papillary or flat carcinomas. When the pathologist reports a biopsy specimen as Grade 1 in Broders' terminology, he certainly takes a great load off his own shoulders, because this grade of tumors includes both the cases which we recognize as benign papillomas, and some of those which Dr. Ewing and I recognize as definitely malignant tumors.

Dr. Barringer's interesting tables will no doubt prove of much value. However, I wish to point out that the diagnosis of infiltrating carcinoma is not purely a pathological diagnosis.

It is also a gross or clinical diagnosis. The papillary carcinoma may infiltrate or not. The flat carcinoma usually infiltrates.

The things I want to stress are the accuracy of the biopsy in arriving at a diagnosis of malignancy; our inability to draw conclusions as to prognosis from biopsy alone; and our belief that cytology alone is insufficient for grading tumors. I feel sure that when Dr. Ewing grades his tumors he is not guided by cytology alone. Certainly the clinician feels that location of the growth and the extent of infiltration are of equal or greater importance in prognosis.

VERNE C. HUNT (closing): I again want to repeat what I said in closing, that cancer of the bladder is still a very serious disease. I think there is great room for improvement in the results, and I think that the only way that such improvement will occur is going to be through a comparison of the results obtained in definitely graded lesions, graded pathologically, and through a comparison of the results obtained by the various therapeutic methods that are employed, surgery, the various physical agents, and what not, which calls to my mind again what Dr. Keyes and I were talking about. He has recently sent out some letters to the effect that all bladder tumors be examined in various clinics and be sent into the registry to be gone over, so that a definite pathological classification of the tumors of the bladder may be accepted, if such a thing is possible. First of all before we can obtain accurate results and compare the relative merit of the various therapeutic agents used, the surgeon, the pathologist and the clinician have got to talk the same language. That can only be accomplished through the registry which has been formulated, so that these tumors are examined at a certain place and by certain men, and some degree of agreement is arrived at.





# POSTOPERATIVE EVENTRATION\*

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THERE is no very extensive literature on this subject, but enough has been written to indicate that such very embarrassing eventration occasionally occurs and not infrequently with disastrous results. Dr. Greenhill<sup>1</sup> has called attention to Madelung's report, in 1905, of 157 cases which he had collected from the literature, and also to the report of Sokolow, in 1925, at the 18th Russian Congress, of 614 additional cases which he had obtained through questionnaires and a review of the literature. The death rate in the 614 cases was 31 per cent. Greenhill finds that sex and age play no part in the occurrence of the eventration. Neither the character of the suture materials used nor of the incisions seems of importance. General weakness of the patient, as from malignancy, seems to be an important factor. Usually the patient, after the accident occurs, notices only a moistness in the region of the wound and a feeling of warmth under the dressings, but pain is usually absent and there is no sign of collapse. The treatment recommended is immediate suture with freshening of the edges of the wound.

During the early years of my practice I had 3 of these cases; the first occurred after, following the usual custom, removal of the stitches at the end of one week. The accident was discovered shortly after, but through the stupidity of an intern there was no notification. When the patient was seen the next morning active peritonitis was present and the patient died. Because I felt that the stitches had been removed too soon the time of removal was extended to ten days. Then after a considerable interval there was a similar occurrence, but immediate notification resulted in a prompt closure and the

patient made an uninterrupted recovery. The time for removal of stitches was then extended to twelve days. For several succeeding years there was no trouble, but then in a fleshy patient upon whom had been made an abdominal panhysterectomy for cancer of the uterus, the wound which had apparently healed firmly split wide open a few hours after removal of the stitches. The surface of the wound was apparently entirely healthy, without the slightest sign of infection. The bowels were replaced, the wound closed in layers as before and the patient made an absolutely smooth recovery. *The removal time was then fixed at fourteen full days.*

About this time I was called to a distant point because an accident had happened to the patient of a surgeon who, after removing the stitches at the end of about one week, had left on the next train for New York. Shortly after his departure the nurse discovered the accident and telephoned for help. A few hours later it was found that the nurse had promptly covered the protruding bowel with sterile vaseline and applied a firm support. In that case also the wound surfaces were free from any evidence of infection. The vaseline was removed as completely as possible, the wound resutured in layers, and that patient also recovered completely.

If at the end of the fourteen full days, there is any evidence of any trouble in the wound, like even a stitch abscess, the stitches are left in until it is evident that all danger is past.

When the wound is closed the peritoneum is first closed with a continuous suture of No. 2 chromic catgut. The adjacent edges of the recti muscles are whipped together with a similar stitch, and the aponeurosis closed with a third similar suture. Silkworm gut stay sutures

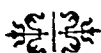
<sup>1</sup> *Am. J. Obst. & Gynec.*, p. 890, June, 1930.

\* Submitted for publication July 15, 1930.

are then inserted which take in the rest of the abdominal wall, no matter how thick, each stitch catching the preceding rows of catgut stitches down to and including a part of the rectus muscle. The skin is approximated by a continuous catgut suture. It is these stay sutures that are removed at the end of fourteen full days, or later as judgment may suggest. Since this period has been adopted out of not less than 15,000 abdominal sections there has not been a single instance of eventration.

We have all known for many years that we may have delayed union in fractured

bones. It is impossible to ascribe any one particular cause for the delay, though several theories have been suggested; but after due time we expect solid union to result. In none of my cases, except the first one, in which there had been a long delay, was there any evidence of infection of the wound, nor was there any trouble in final healing. The same condition is quite uniformly reported by other surgeons, so that the explanation suggested here would seem to be correct; viz., simply an unexplained delay in the union of the wound, as is occasionally seen in a fractured bone.



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\*Continued from p. 92.

# THE CORRECTION OF PENDULOUS BREASTS\*

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**W**HETHER the reasons for such correction are largely esthetic in deference to modern trends of style and vogue, or whether it is performed on strictly pathological grounds, is immaterial once the step has been decided upon; and while the decision for it is made by the patient, it is the surgeon's responsibility to evolve a technic which will produce the best possible result with the least risk.

The American literature on this subject is very limited, while in Germany and to a lesser extent in France, it has become very voluminous in recent years. A perusal and digest of these published efforts present much that is valuable as a guide, but there goes all through it a singular lack of appreciation of the pathology involved and hence present methods of restoration and results are surgically and esthetically often questionable.

**Pathology:** Only gross pathology needs to be considered here. The basal attachment of the gland to the chest wall is usually normal, the prolapse being due to stretching of the fibrous tissue and vessels extending from the base to the gland, virtually resulting in a pedicle formation. This is best illustrated by having the patient bend fully forward, when the heavy gland may be seen to swing on its pedicle almost as a pendulum. Visualization of the abnormality in this light points the way to satisfactory restoration, by shortening and broadening this pedicular attachment. Excessive adipose tissue is periglandular largely and easily separable. Excessive adenomatous development calls for excision of one or more radial segments of the gland. In the milder degrees of pendulousness, there may be no excess of either fat or gland tissue, in which case only a shortening of the pedicle is required. There is not in the true sense a suspensory ligament holding the breast in place. The pedicle

contains all the important vessels and nerves supplying the gland, and its fibrous tissue forms the essential supporting element of the breast.

Normal physiological function is usually greatly impaired in an enlarged and pendulous breast, and may or may not be improved by operation; hence little attention is paid to this phase of the matter. Chief consideration is given to the esthetic factor of harmony in proportions, contour and appearance. For this reason, and that the result may not be more of a mental depressant than the original condition, it is well to study separately each factor involved and spend much time in visualizing and planning the intended transformation.

## *Objects of the Operation:*

1. Restoration of the gland to its normal location.
2. Restoration of the normal breast contour.
3. Permanent fixation but normal mobility.
4. No disturbance of essential blood and nerve supply.
5. Unimpairment of secretory function.
6. Absence of telltale scars.

In the grossly abnormal breast, these requirements are satisfactorily met by a procedure which entirely frees the gland from its cutaneous attachments, and transposes it *in toto* with nipple attached, from its abnormal to its normal bed; in the lesser degrees of pendulousness the great number of methods advocated hitherto offer the best proof that none of them are very satisfactory.

The procedure presented herewith simplifies the problem to such an extent that while there is still some variation in the manner of skin incision, there is but one fundamental technic. The incision varies with the size of the gland and the degree of

\* Submitted for publication May 19, 1930.

prolapse, as indicated on the schematic diagram. This shows in vertical striations the skin area to be undermined, and in

normal anatomical breast border is visualized as a perfect circle, the lower portion of its circumference coinciding with the exist-



FIG. 1. Front View; patient aet. thirty-one.



FIG. 2. Side View; patient aet. thirty-one.

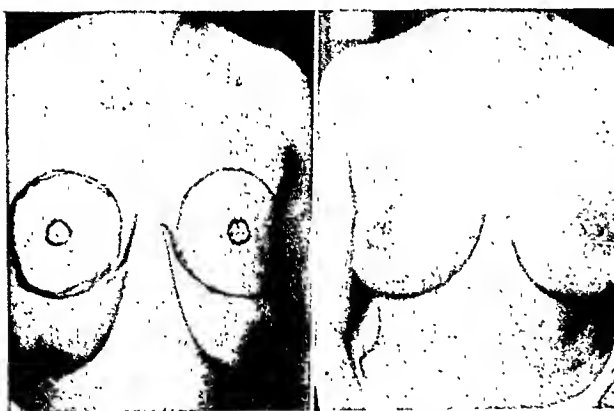


FIG. 3. Front View; patient aet. fifty-eight.

FIGS. 1-3. Before and after operation showing design and application.

horizontal striations the amount of superfluous skin to be excised.

*Designing:* From the esthetic viewpoint, this is the most important step. Actual measurements are helpful, but of greater value is innate artistic talent and a sense of proportions. With the patient in the upright position, sitting or standing, the

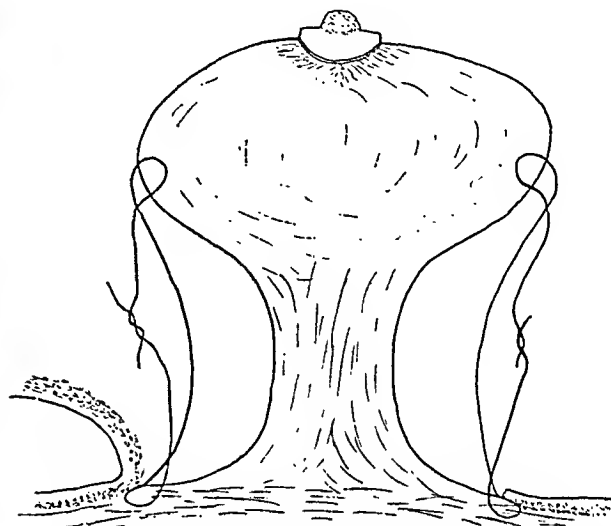


FIG. 4. Sketch of the gland substance of a pendulous breast freed entirely from its cutaneous attachment, but leaving the nipple and areola in situ. All superfluous fat has been removed, revealing clearly the pedicle nature of the attachment of the gland. The important constituents of the pedicle are undisturbed. Catgut sutures are in place for plication. A row of sutures so placed from a circle of suspensory ligaments around the entire lateral margin of the gland, thus insuring a firm fixation.

ing groove between gland and chest wall. Center and periphery are marked out, delineating the lower border in two parallel lines (in this position anterior and posterior to the gland substance or pedicle). While ideally the nipple should be in the center of this spheroid, actually in any but the small and very firm breast, it is usually found to be about one inch below the center; a more normally appearing final result will be obtained if thus projected, rather than in the geometrical center.

For marking, we use a 5 per cent alcoholic solution of brilliant green. Front and profile photographs with the markings in place constitute a desirable part of the case record and are often of considerable help in the planning of the work.

Experience has shown that it is better to make the new locus for the nipple no larger than one inch in diameter; the circumcised areola shrinks greatly, while the new opening stretches considerably. After the designing is completed, the patient should

assume the recumbent position that the surgeon may thoroughly familiarize himself with the changes in contour and design

after isolation this nipple and areola will shrink to a diameter of only about 1 in.

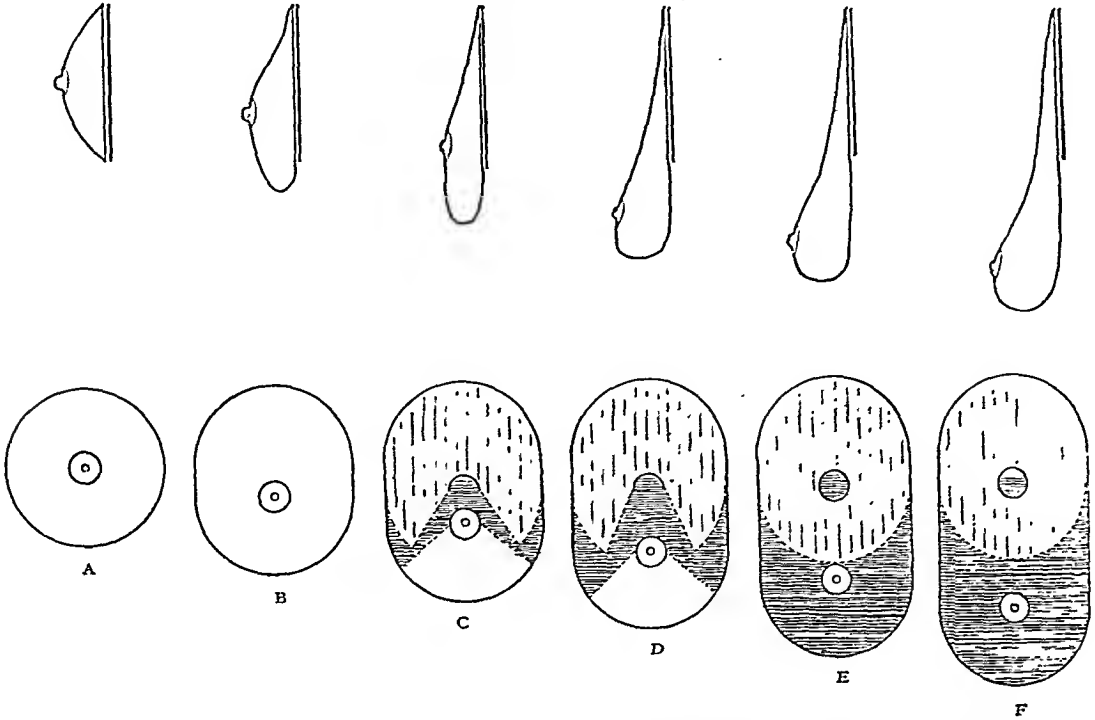


FIG. 5 A. The ideal breast. The theoretically ideally proportioned breast, nipple in geometrical center, breast diameter 5 inches, areolar diameter 1 inch. B. Normal average breast, showing 1 inch droop. Nipple 1 inch below ideal center. This is type of breast we aim to create, rather than ideal; the result is more natural. C. Two inch prolapse. Breast and nipple show a 2 inch droop, requiring a 1 inch elevation. Transversely shaded area shows the amount of skin to be removed; vertical striations show area to be undermined. D. Three inch prolapse, bringing the nipple to average base line, and representing the greatest descent which can be corrected without complete isolation of the nipple. E. Four inch prolapse. This brings the nipple below the average normal base line of the breast, hence it requires complete isolation from its surrounding skin, all of which is eliminated after the gland, with attached nipple, has been transferred into its normal bed. F. Five inch prolapse. This and any further degree of descent presents the identical problem and requires the same treatment as depicted in the 4 inch prolapse.

effected by the change in position, the most noteworthy change being that the newly designed locus for the nipple is now no longer round but is oval transversely. In operating, the pattern outlined by the design must be followed if one would have a desirable esthetic result.

**Operation:** The new nipple locus is made by incising as per diagram and ablating the disk of skin outlined. The areola is circumcised next, but with this thought in mind, that a smaller areola than usually exists in a pendulous breast should be formed in the new breast; hence the diameter of the incised circle seldom exceeds 2 in. though the existing actual areolar diameter might be 3 to 4 in.; immediately

The nipple itself is connected to the gland only through the milk ducts, incidental fibrous tissue and smooth muscles, which does not provide a very strong connection. The areola, however, is connected with the stroma by a very firm fibrous tissue. This must be kept in mind while the areolar incision is being made, lest an accidental pull or tug during blunt dissection tear loose the nipple. This incision is therefore not deep enough to reach the subcuticular fat directly, but rather slants out radially after it has gone through the skin, so as to preserve a large amount of this fibrous tissue attachment.

After the two skin incisions denoting the

new lower borders of this bed have been made, almost all further dissection is by means of the hot sponge. The gland can easily be separated in this manner with scarcely a trace of bleeding. Not only is the gland thus taken from the skin pocket in which it rested heretofore, but this pocket is thus simultaneously eliminated; the new bed is prepared similarly by undermining fully to the outlined borders. An average thickness of half an inch of subcutaneous tissue should be left adherent to the skin to insure its nutrition. Any superfluous fat is picked away until we have a clean, well-defined gland, attached to its base by an elongated pedicle of 4 to 5 in. diameter. If the gland is still too large after removal of all superfluous fat, a radial section or several such sections, taking in the entire thickness of the gland from periphery to areola, may be safely excised. These sectors are taken from the lower half of the gland to minimize size and weight below the nipple. Such sectioning furnishes the only chance of striking a bleeder, which may be promptly ligated and the section closed by approximation with catgut. Shortening of the pedicle is accomplished by plication. Interrupted sutures of chromic catgut secure first the four poles; these sutures bite through the periphery of the gland about midway between base and nipple and are anchored to the pectoral fascia. Whatever additional number of sutures may be needed to secure a firm marginal attachment are thus placed.

The nipple is then made to emerge through its new locus, and its poles are anchored with interrupted sutures, which may be catgut subcutaneously, or dermal extending through fascia and skin. Closure may be by continuous subcuticular catgut, by subcuticular dermal, or buttonhole suture with dermal. In freeing the gland the empty sac of skin was ablated and the lower circumference may now be closed

with a choice of methods as for the nipple area. Two or three rubber tissue drains extending throughout the undermined skin and emerging through the lower incision are advisable for twenty-four to forty-eight hours. Considerable padding in the dressing and a snug fitting binder are indicated.

A successful outcome depends primarily on the elimination of the etiological factor, viz.: excessive size and weight of the breast; secondarily, upon anatomically sound fixation; thirdly, upon restoring normal skin topography.

Careful observance of each step of this technic virtually eliminates all the supposed dangers usually cited for this operation, namely: prolonged anesthesia, vascular impairment leading to partial necrosis, sloughing of the nipple, unsightly scars and impermanence of the result.

The operation for lesser prolapse differs essentially only in the manner of disposing of the excess skin and restriction of the dissection and plication to the upper part of the breast. (See accompanying sketch.)

#### SUMMARY

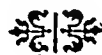
1. To secure a satisfactory esthetic result, the intended transformation must be projected with the patient in the upright posture.

2. Scar lines are rendered invisible by being blended with the areolar circumference and with the lower gland border circumference.

3. The operative time is greatly shortened and the procedure rendered almost bloodless by blunt dissection with hot sponges.

4. The gland is transplanted functionally intact into its normal bed and the abnormally long pedicle is shortened by plication; this assures a permanent result, as normal as possible in every respect.

[For References see p. 106.]



## DIAGNOSIS AND TREATMENT OF TUBERCULOSIS OF THE GENITAL TRACT\*

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IT is now three years since the last meeting of the Société Internationale d'Urologie in Brussels. At that time the treatment of genital tuberculosis in the male was chosen as one of the chief topics for discussion. It was hoped that by concentrating the international mind upon the question it might be decided for good and all whether genital tuberculosis is primary in epididymis or prostate. Each contributor to this discussion took a different point of view. Walker<sup>1</sup> of London made a convincing argument in favor of the prostatic origin of the disease, one of us (J. D. B.<sup>1</sup>), together with Dr. F. H. Colby, furnished unquestionable proof that the disease arises primarily in the epididymis, while Gamberini<sup>1</sup> of Bologna, pursued a middle course and said, "in the actual state of our knowledge, we cannot assert which is the most frequent starting point of the tuberculous process."

And thus, still in a state of flux, the matter rested when the meeting ended and so it rests today. The only contributions of outstanding value which have been made to the literature since then are those of Young<sup>2</sup> Hinman<sup>3</sup> and Bumpus and Thompson.<sup>4</sup> Few, if any, problems have occupied the stage for so long or so frequently or have called forth the united efforts of so many clinicians and laboratory workers.

It is unnecessary at this time to review even briefly the very numerous experimental investigations. These have occupied the attention of many of the most brilliant workers in almost every nation. The upshot of it all is that the quarrel still goes on as to whether tubercle bacilli travel only in the direction of the secretion in the vas and lymphatics (the so-called descending theory) or whether, at times these

organisms can travel in the opposite direction (the so-called ascending theory). The work of Frey,<sup>5</sup> recently published, seems to show convincingly that neither semen nor dye solution is passed toward the testis in the lumen of the vas. Nor can the contents of the urethra ever enter the testis through the vas. The devastations of the tubercle bacillus can be explained in certain instances only on the ground that they were brought to the scene by a hematogenous route. For it is conceded by all who have investigated this problem that the genital lesion is but another local manifestation of a primary focus elsewhere in the body, this focus being generally in the lungs or bronchial glands.

In examining and evaluating the clinical evidence of the literature as well as that reported by post-mortem observers one is struck by the fact that few if any of these reports state clearly whether they are dealing with genital tuberculosis as such or with genitourinary tuberculosis. In the latter event various factors come in which may confuse the issue. On the other hand, it is extremely common to find in the same patient both urinary and genital tuberculosis and while the former cannot always be proved it is frequently suspected.

All writers have stressed the frequent coincidence of kidney and epididymal tuberculosis. In a previous analysis of a series of 154 cases one of us (J. D. B.<sup>6</sup>) found renal tuberculosis in 18, an incidence of about 11 per cent. So far as it was possible to determine, the genital lesion had preceded the renal lesion in 11, but this and further experiences in the matter of trying to say which lesion precedes the other make us feel that the question can never be accurately answered. There are

\* Read before the Section of Genito-Urinary Surgery, New York Academy of Medicine, February 19, 1929.

various reasons for this. Urinary tuberculosis may cause little or no bladder disturbance or even if it exists it is difficult for a patient to say just when it began or just what relation its onset had to the onset of his epididymitis. Both are often unbelievably insidious. Furthermore, who can say that the abscess in the medullary portion of the kidney which is intact today may not rupture tomorrow, infect the pelvis and give rise to the usual train of symptoms associated with renal tuberculosis. This point should be borne in mind by those who advocate the radical removal of the entire seminal tract. Surely no wise judgment would sanction such an operation in the presence of renal tuberculosis or if its onset was even remotely likely. Yet who can say that it is not always hovering in the background.

For the purposes of the present discussion we have gone over the records of 184 cases of genitourinary tuberculosis occurring at the Massachusetts General Hospital in the past eight or ten years. These cases have never been drawn upon before for data. Among them there were 48 instances of recognized renal tuberculosis, about 26 per cent. In some the kidney had been removed before the patient came to the hospital for the relief of his genital infection, in others the kidney process was bilateral; in certain others the kidney was removed subsequent to the treatment of the epididymal lesion and finally, in many it was recorded only as an additional diagnosis. The point is, however, that in but a few of these cases was it possible by any clue discoverable in the history to determine which came first, the genital or urinary infection.

Furthermore, it was found that in 101 cases (54 per cent) the urine contained pus, blood, casts, or tubercle bacilli in one or another combination and in greater or less amount. It was also found that 74 patients (40 per cent) complained of urinary symptoms (frequency, dysuria, urgency, nocturia, etc). Subtracting from the 101 cases with abnormal urine and the

74 with bladder symptoms the 48 who were known to have renal tuberculosis it is obvious that there were still many whose tuberculous epididymis caused a train of symptoms such as one usually associates with renal tuberculosis. Nor can one be sure without continuous observation of these cases whether some did not in fact have latent early renal tuberculosis. We have gone into this phase of the situation at some length because we believe it has an important bearing upon the matter of treatment, a subject which will be taken up in its appropriate place.

It has already been stated that no agreement was reached in Brussels three years ago; it is also true that no further light has been thrown on the subject since that time. While, therefore, we cannot offer any very new arguments we can perhaps stress some of those already put forth.

All authors are in accord that in juvenile patients the prostate and vesicles are attacked by tuberculosis much less frequently than in the adult. Kantorowicz,<sup>7</sup> in 57 cases of epididymal tuberculosis in children found the prostate involved but twice. In 6 cases of young boys in our Clinic some years ago there was no demonstrable prostatic or vesicular involvement. Two of these cases were examined at autopsy. In another case there was a demonstrable lesion in the seminal vesicles but two years later, tuberculosis of the second epididymis and of one kidney having meantime intervened, the record states that "the prostate is normal and the seminal vesicles are not felt." Since these observations were made we have seen several other children with genital tuberculosis and in none was there clinical evidence of involvement of prostate or vesicles. And yet, in young children, especially when under an anesthetic, it would seem impossible to overlook a tuberculous lesion of the vesicles or prostate. It would appear, therefore, that the evidence to be gained from our juvenile patients is of great value. We believe the relative immunity of their internal genitalia



can be ascribed to the lack both of functional and physical development common to this time of life.

Another point to be considered is the condition of prostate and vesicles in relation to the stated duration of the epididymal tuberculosis. In a series of these cases studied some years ago by one of us (J. D. B.<sup>6</sup>) data were obtained in 99 such patients. In the first six months of the disease prostate and vesicles were found infected in 40, apparently normal in 15; from six months to one year there were 14 infected, 3 normal cases. In others, after the first year and often after the elapse of many years, the prostate and vesicles were recorded as tuberculous in 20, negative in 7. In other words, about 40 per cent are infected within the first six months. But one must not overlook the not inconsiderable number of patients who present an apparently intact prostate and vesicles even many years after the onset of tuberculous epididymis. We consider this an important observation and one which has been too briefly mentioned before.

Why, may we ask, if the prostate is the primary source of genital tuberculosis, do we not find it invariably involved and also at the very onset of the disease? Yet such does not seem to be the case. Also, what is the explanation of some observations reported by Cunningham<sup>5</sup> in 1916? He found 35 cases of tuberculous epididymitis among 4250 autopsies. The disease was bilateral in 15, unilateral in 20. The vesicles were involved in 25 and the prostate in 25. This leaves 10 cases in which there was no involvement of either prostate or vesicle and yet the epididymis was tuberculous. How can this be explained except on the ground that the disease was primary in the epididymis in these 10 cases and possibly so in the others.

Another finding of Cunningham's which is of interest, but more particularly to those who take the opposite view, were 2 cases with caseous tuberculosis of the prostate but without involvement of the epididy-

mis. In other words, this is apparently just the material which our opponents would lead us to believe is so common but which we never see.

Not much can be gained from autopsy material in these cases because of the fact that the patients generally show miliary tuberculosis or advanced lesions. A total of 7 of our hospital patients have now died, 4 following operation (giving a mortality of only 1.5 per cent). Post-mortem examination was done in 6. In a boy aged six years, with a unilateral process of two months' duration (epididymectomy had been performed) the bladder, prostate, seminal vesicles and opposite testis and epididymis showed no evidence of disease. In a man of thirty, having a right nephrectomy at another hospital, it was found that the prostate showed an old healed tuberculous process. No mention is made of the seminal vesicles nor of the right testis and epididymis. The left testis and epididymis were healthy. In the other 4 cases practically every organ in the body shared in the flood of tuberculosis. But we feel it is significant that in these 2 cases the prostate should be intact in the one and show a healed process in the other.

As to the diagnosis of tuberculosis of the epididymis it may not be in the least difficult in certain cases. Induration, enlargement and nodularity of the organ, involving especially the lower pole, with but insignificant pain or tenderness are among the chief diagnostic features. If in addition to this the corresponding vas is thickened and nodular, somewhat resembling a chain of beads, the evidence is strengthened. Most important of all, however, is the presence of a healed or active sinus for, so far as we know, no other disease of the scrotum will produce this particular condition. In certain cases the presence of a hydrocele will so mask the scrotal contents that its removal is an imperative first step toward diagnosis. Once in a lifetime tubercle bacilli can be demonstrated in the aspirated fluid. It must be remembered, however, that even

the most expert may sometimes go wrong in the matter of diagnosis in scrotal conditions. He may be dealing with an epididymitis of an unusual type produced either by the gonococcus, a pyogenic coccus or the colon bacillus. It may even be a case of torsion of the testicle (of which one of us [J. D. B.] had a splendid example within a week) with symptoms of such a character that tuberculosis comes first to one's mind. The surgeon must be especially on his guard for those cases of tumor of the testicle which, beginning in the epididymis may present a most uncanny likeness of tuberculosis of that organ. Three of these have now come under the notice of one of the writers (J. D. B.<sup>9</sup>) and in all he made a diagnosis of tuberculosis. It is impossible to enumerate *seriatim* and *ad infinitum* all the conditions which may be mistaken for tuberculosis. Our best advice is to make the most careful examination possible and if, after reasonable observation, the diagnosis does not become absolutely clear then we advise exploration. In these days of local anesthesia such a procedure is performed with so small a risk and with so little discomfort that it is better to take this risk than to let the patient go with a possible neoplasm or other undesirable lesion. Hinman<sup>3</sup> says that because of this frequent difficulty of differential diagnosis he has "made it a rule to perform epididymectomy first and have an immediate pathological examination made before proceeding to remove the vesicles."

It goes without saying that no attempts at the diagnosis of a scrotal condition are complete without careful and perhaps repeated rectal examination. The typically tuberculous epididymis of months' or years' duration will give rise to the characteristic changes in the seminal vesicle and the lobe of the prostate on the same side, or even both sides may share in these changes. These changes consist of a very definite induration and nodularity and generally more or less increase in size of the affected parts. Sometimes they are pronounced, sometimes detected with dif-

ficulty and only after repeated examination. As no one has ever noted these changes in the vesicles and prostate in 100 per cent of cases it is to be expected that even in well marked tuberculosis of one or both epididymes the rectal examination may sometimes yield no positive information. It is in just these cases that the diagnosis of the scrotal condition may be confusing. We cannot agree with Keyes<sup>10</sup> who sets an arbitrary time limit of three months before finally committing oneself to an opinion. We feel that long before the elapse of this time serological tests and other information should lead to a correct conclusion. This is too long a time to carry around a possible incipient neoplasm.

The treatment of genital tuberculosis will depend largely upon what the surgeon believes to be the primary focus of the disease. If he thinks that the prostate and seminal vesicles are the point of origin of the disease he will advocate the radical and extensive surgery which removes the entire genital tract. If he believes that it begins in the epididymis he will advocate conservative surgical measures, namely, epididymovasectomy, accompanied by orchidectomy in the few cases where the testicle has been attacked. In either event the patient should be regarded by the surgeon as a case of tuberculosis with a local manifestation and will, therefore, be given all the hygienic treatment which such patients have a right to expect.

There is no doubt that Young is the leader of the radical party. A few have followed his ideas to a greater or less degree but it is quite apparent that they have dulled the edge of radicalism by carrying out conservative measures in certain instances. Quinby,<sup>11</sup> Hinman,<sup>3</sup> the Mayo Clinic,<sup>4</sup> Whiteside,<sup>12</sup> Sacco,<sup>13</sup> Dillon,<sup>14</sup> and K. M. Walker<sup>1</sup> are among those who have practiced more or less consistently the doctrines of Young. Let us discuss Young's latest publication on this subject, published in June, 1928.<sup>2</sup> He says:

Owing to the distress in which many of these patients are found on account of extensive

involvement of the lower urinary and genital tracts, we have not hesitated to carry out this operation . . . even in the presence of pronounced pulmonary tuberculosis, hardly expecting to afford more than alleviation of pain and dysuria and not hoping to arrest the tuberculosis elsewhere, nor have we hesitated to carry out the operation in the presence of tuberculosis of the kidney . . .

It would appear from these words that the operation is not the only radical element in Young's teaching. I think most of us will agree that, generally speaking, when a patient is in the condition of extensive and advanced tuberculosis described by Young, he is not a good candidate for radical surgery.

Young has reported 22 cases. There has been no operative death to date, but of course we all realize that that is a matter of luck. Any case of tuberculosis is likely to develop the miliary or meningeal form of the disease after any operation and in another portion of his report Young states that he has had 2 such cases. As we do not know of any recoveries from this form of tuberculosis it is to be expected that there will be an operative mortality in Young's next report. Young speaks of 4 cases having intermittent urinary fistulae but he thinks such a fistula is to be regarded not only as a safety valve but also an indication of the persistence of tuberculosis. We agree with the latter opinion. On the whole we feel that up to date Young's success in this radical field has been remarkable and while we are by no means convinced that he is on the right track, we none the less give him all the credit which is his due. Often the case that seems utterly hopeless will survive and this is especially true of tuberculosis.

Bumpus and Thompson<sup>4</sup> report 9 such radical operations on patients from the Mayo Clinic. Four of them are dead, 4 are living, 1 has not been traced.

Quinby<sup>11</sup> has reported 6 such cases. We have no details but are told that "the procedure did not, however, always prevent the later development of the disease

in the remaining epididymis and in several cases a persistent perineal sinus developed."

Hinman<sup>3</sup> reports the results of 13 radical operations. Two of the patients are dead, 2 have been lost track of and 9 are living and well. The results in these have apparently been satisfactory, "except for the perineal sinus which has persisted months to a few years" where there was a partial prostatectomy. Hinman says that the "results in those cases that have been treated radically are . . . much superior to the results of those treated by simple epididymectomy or untreated." His views are sane, rational and based upon an experience which has included the more conservative epididymectomy.

Walker<sup>1</sup> expresses his feeling toward radical surgery by remarking that no matter how radical the operation some focus must remain either inside or outside the genitourinary tract from which new invasions may take place and fresh organs become infected. He feels that although the radical operation is justified on the grounds of pathology it has not yet justified itself in its results. He thinks it should be reserved only for special cases, wherein the more conservative measures have failed.

Gamberini<sup>1</sup> of course thinks less than nothing of radical surgical methods and hesitates often to use conservative surgery. His experience of more than thirty years with the iodine injection treatment of Durante has convinced him that this is the best.

Turning now to the less radical measures we find ourselves in an equally distinguished but much larger group of adherents. One of the writers (J. D. B.) has not only performed but has followed the results of epididymectomy for twenty years at the Massachusetts General Hospital. This has involved more or less intimate contact with nearly 500 cases. As a result of this experience we can state with absolute assurance that epididymectomy has proved to be an entirely satisfactory operation from the point of view both of

patient and surgeon. In traeting 113 cases from one to twenty-five years after operation it was found that 27 per cent of the patients had died from some form of tuberculosis; 85 per cent of deaths occurred within the first six years after operation. There were only 4 operative deaths, a mortality of 1.5 per cent. An examination of a large number of this group, in many eases many years after operation, showed that the induration, nodularity and enlargement of prostate and vesicles which existed at the time of the epididymectomy had disappeared entirely or largely decreased. In a very few the condition was the same as at operation. In but 2 cases to our knowledge has the process in prostate of vesicles progressed since operation. Since this investigation was undertaken we have followed a great many other eases for various lengths of time after operation and the same favorable results have been noted.

It is not claimed, of course, that many cases have not died of tuberculosis and that other outbreaks of the disease have not occurred subsequent to the epididymectomy whether it was unilateral or bilateral. But there is no question whatever that with very few exceptions these patients have been relieved of the objective and subjective symptoms which formerly beset them.

Nor is our experience unique. Others have investigated large numbers of cases of genital tuberculosis for many years after operation with varying, but on the whole good results. Lapeyre<sup>15</sup> reported 75 per cent of cures from four to ten years after operation. Von Bruns<sup>16</sup> has reported 46 per cent of cures in unilateral eases of three to thirty-four years duration and 56 per cent of eures in bilateral eases in a similar length of time. Frohnstein<sup>17</sup> has reported 80 per cent of cures following epididymectomy after ten years. Hunt<sup>18</sup> has followed 49 eases from the Mayo Clinic of which 88.5 per cent are either well or markedly improved. More recently Bumpus and Thompson<sup>1</sup> have discussed a series of 175 eases with epididymectomy.

Eighty-five (48.5 per cent) are known to be alive for from five to seventeen years after operation, 13 others were in good health when heard from during the five-year period. Eighteen patients (10.2 per cent) died from tuberculosis of the urinary traet; nephrectomy had been performed in 16 of these at the time of their examinations. Seven of the 99 patients who were free from renal tuberculosis at the time of operation later contracted the disease. Fifteen patients (8.6 per cent) died from pulmonary tuberculosis; in every case its presenece was known at the time of operation but was not considered far enough advanced to be a contraindication. Four patients (2.2 per cent) died from other forms of tuberculosis, making a total of 21 per cent of eases in which death was attributable to tuberculosis.

It is interesting to compare this very satisfactory report with that of 125 cases who had no surgical treatment at all. Forty-two of these (33 per cent) not operated upon are alive from five to seventeen years after examination. Thirty per cent of this surgically untreated group have died of some form of tuberculosis, an incidence about one-third higher than in those who had surgical treatment.

Before leaving the subject of epididymectomy we wish to dilate for a moment upon what we believe to be the great superiority of the technic employed by us over that in general use. This operation was described in much detail, with illustrations, in an article by Cabot in conjunction with one of the present writers (J. D. B.)<sup>19</sup> and published in 1913. The scrotum is opened as usual, existing sinuses, ancient or active being exeised by a raequet-shaped incision in the skin. The epididymis is removed from the testis in the usual manner, care being taken to avoid the blood supply of the testicle. After the epididymis has been freed from its eonnection with testicle and scrotum it can be removed from the vas. The vas is then freed by blunt dissection from its attachments to the spermatic eord, this dissection being carried by the finger and by traetion well up toward the external inguinal ring. A curved clamp is then

placed on the vas at about this point and guided by the surgeon's hand on the outside the point of the clamp containing the vas is worked along the inguinal canal until it is at a point opposite the internal inguinal ring. All this is done with the utmost ease. The point of the clamp is then pushed out against the skin and on this point an incision is made with the knife about 1.5 cm. in length and parallel to Poupart's ligament. After the skin, fat, superficial fascia and the aponeurosis of external oblique muscle are divided, the end of the clamp containing the vas is pushed out. The vas is then seized with another clamp and pulled out through the incision, the first clamp meantime having been released and drawn out of the inguinal canal in a direction opposite to that by which it entered. The vas is now further freed by traction and blunt dissection so that anywhere from 2 or 3 to 5 cm. are gained on its length beyond the internal ring. It is now clamped, ligated behind the clamp and divided, the cut end being thoroughly cauterized or carbolized. When released it retracts into the depths of the wound. The skin wound alone in the groin is now closed with a subcutaneous silkworm suture. Having carefully attended to all hemostasis, a point which we believe to be of the utmost importance, we place a small rubber tissue wick in the scrotum beginning well up toward the external ring and coming out at the lower end of the scrotal incision. The latter is closed like the inguinal incision with subcutaneous silkworm gut. The gauze dressing is then held in place with an Alexander bandage, than which we feel there is nothing better. In the event that the testis is definitely involved it should of course be removed. We are constantly surprised, however, to find that many testes which at first look unpromising prove to be actually healthy. But even though a considerable amount of tuberculosis is found in the testis, unless it be in the form of miliary tubercles, this can be excised up to the point where perhaps half of the organ is sacrificed and yet

the remaining tissue will survive. We have knowingly left a good deal of tuberculosis in a good many testicles, but have as yet had to remove the testis at a subsequent time in but 3 cases. It is ever a source of amazement that the organ can survive in the midst of so much tuberculosis.

This really simple operation has been described at such length for the reason that we are certain that it does away, so far as is possible, with the postoperative fistulae which were once so common and which make a patient's existence a doubtful pleasure. We have not, in fact, seen such a fistula for many years. These fistulae were particularly common at the region of the external inguinal ring for the reason that the vas deferens was always divided at about this point. As a matter of fact this was often deliberately done and quite as deliberately the stump of the vas was sutured to the skin for better drainage. Sometimes this drainage was altogether too good and too prolonged to satisfy the patient. Then too it was formerly considered advisable to inject the protruding stump of the vas with phenol or iododorm, the idea being that it would eventually clear up the tuberculosis still remaining in the vas and in the seminal vesicle of that side. Many favorable reports of this method of treatment are recorded in the literature but in spite of this its popularity seems to have waned and little or nothing in this direction has been done for some years.

The division of the vas deferens at a point well over the pelvic brim is logical from a pathological standpoint for the reason that here the vas is often but little if at all invaded by tuberculosis. This phenomenon is explained by K. M. Walker<sup>1</sup> who says, "This theory of a descending wave along the perivascular lymphatics and a returning wave through the lumen of the vas would explain why in so many cases one finds a peripheral infiltration of the prostatic end of the vas and a central infiltration of the distal end." While this explanation is ingenious and to

a certain extent logical we do not agree that it is the final answer to a question which has long puzzled all investigators.

The question as to what if anything shall be done to the opposite and presumably healthy epididymis requires careful consideration. Experience shows that the second epididymis will become tuberculous in a large percentage of cases within a comparatively short time after the onset of the disease in the first side. It, therefore, seems justifiable to take such steps as will prevent this unhappy event. Not only this but it also seems justifiable to take these steps at the time of the operation on the first side. Also, it is a fact that a large number of cases of unilateral tuberculous epididymitis will be found to have azoospermia (85 per cent in one series reported by J. D. B.). If, therefore, the patient is already sterile the surgeon should inform him of the present status and of the future possibilities and recommend that the vas of the healthy side be not only divided but a portion of it (about 1 cm.) excised, together with the surrounding tissues containing the lymphatics. We have done this in a number of instances with gratifying results. In a few cases epididymitis has developed due no doubt to the fact that the disease was present at the time of operation but was so slight that it escaped detection. It is hoped that at some future time a detailed report of this phase of the subject can be given.

It has already been stated that as a corollary to the surgery of the tuberculous, whether radical or conservative, hygienic treatment of the most intensive variety should be given, covering as long a period of time as possible. Besides the usual routine attention to details of diet, liquid intake, rest and exercise this involves not only all that we know at the present time about heliotherapy but also tuberculin. As Walker<sup>1</sup> well says, "Could every patient be removed to a good climate and be provided with suitable sanatorium treatment and exposure to sunlight it would seldom be necessary to

resort to the extensive operations that have been advocated . . . "

Myle<sup>20</sup> has shown convincingly that heliotherapy causes rapid healing of scrotal sinuses and a general regression of all tuberculous lesions of the urogenital tract. His belief is sound that genital tuberculosis is but a local manifestation of a generalized process and, therefore, that success will come only by treating the disease and not one small part of it. His regime is long and strict and would be impracticable for many patients. But it shows what can be done by sunlight and it is possible that this alone might suffice in certain early cases.

Wildbolz<sup>21</sup> has discussed the effects of heliotherapy but apparently has so far met only with disappointing results. Marion<sup>22</sup> on the other hand, thinks highly both of heliotherapy and ultraviolet light as important aids to the treatment of genital tuberculosis. We confess to have had but little actual experience with heliotherapy real or artificial. So far as we have seen it, however, we feel that it is of the utmost value.

As regards tuberculin we have already expressed ourselves as being heartily in its favor. As a substitute for operation its value is nil but as an adjunct after operation it is of unquestionable value. We have conducted a tuberculin clinic for over twenty years at the Massachusetts General Hospital in association with the Urological, Surgical and Orthopedic Departments. All of our operated cases have been sent to it and have been followed in it for long periods of time. As a result we are in favor of its continuation. More recently Wang<sup>23</sup> in an exhaustive article on the subject of tuberculin and urogenital tuberculosis concludes that tuberculin is not a cure for the disease. He finds, however, considerable evidence that it aids in building up the general health of patients with this type of disease. In the treatment of inoperable and postoperative patients it has seemed to be a helpful factor in the regimen of treatment. To all this we agree and for this

reason we strongly urge its use in appropriate cases.

Generally speaking, we feel that not sufficient use is made by most of us of the powerful natural agents at hand, chief of which are sunlight, fresh air and proper food. These elements rightly handled are bound to be valuable aids to any other form of treatment.

In dealing with a subject so elusive as genital tuberculosis one feels something like a sense of defeat come over him at the end of each survey of the available knowledge of the subject. One can adhere to this or that belief as to the starting point of the disease but perhaps Gamberini is right when he says, "in the actual state of our knowledge we cannot assert which is the most frequent starting point . . ."

We have gone over the data on 184 additional cases of genital tuberculosis, many (26 per cent) of these having urinary tuberculosis as well, in the hope that some new phenomenon would appear, but it has not. The data are so nearly like those of several other analyses made in the past that they are not given here. We were struck, however, by the apparent increase in the number of renal cases as well as by the large number of cases with either urinary symptoms or a pathological urine indicating perhaps an early or latent renal involvement. In other words we feel that urinary complications are so important a factor that it should influence the surgeon strongly against a radical operation when it is obvious that other foci still exist. The fact that the most tuberculosis riddled and apparently hopeless patient may survive one or more extensive operations does not necessarily hang a laurel wreath

upon the surgeon's door. It simply indicates that the patient had a latent and unsuspected store of vitality.

It is well known that even the most simple operation on a tuberculous patient may induce meningitis or miliary tuberculosis. Caulk has reported two such deaths after simple epididymectomy and such an operation preceded the deaths of 4 of our patients. If, as a very widely scattered and long continued experience shows, patients not only survive epididymectomy but are kept perfectly comfortable by it over a long period of time why increase the risk by advocating more radical measures? And especially so since we are told by even the radical surgeons that the fire still rages in other parts and annoying fistulae add to the misery. Force is added to our argument when we find, not only that those who are subjected to the conservative operation are not only made comfortable but also that the objective symptoms disappear as well. We have repeatedly called attention to the fact that the indurated, nodular thickened prostate and vesicles retrogress to the point of clinical cure after epididymectomy. It is hard on the one hand to see how one can wish for anything better or to see, on the other, how under these circumstances the process can have originated elsewhere than in the epididymis. In further substantiation of this belief, we again call attention to the fact that in a very considerable number of instances the prostate and vesicles have been negative to rectal examination even after years of tuberculosis in the epididymis and that many negative findings are recorded on the autopsy table.

[For References see p. 79.]





# ROENTGEN SIGNIFICANCE OF GAS UNDER THE DIAPHRAGM

## AN UNUSUAL CASE WITH DISCUSSION\*

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THIS case is of importance from a diagnostic standpoint. The value of a very definite x-ray finding was questioned and even following a laparotomy was thought to be misleading. At the operation the surgeon found nothing to account for the gas under the diaphragm. The x-ray finding of gas under the diaphragm in the absence of an injury can mean only that there has either been a rupture of a hollow viscus or that there has been a fistulous tract between the lungs and the peritoneal cavity. Vaughan and Singer state that "almost without exception every acute abdominal condition with a free gas bubble is a case of perforative peritonitis from rupture of a gas containing viscus."

In this patient there was no history or evidence of an injury to the chest, abdomen, or pelvis. There was no chance of the air being secondary to a fractured rib or a penetrating wound of the abdomen. There had been no paracentesis with the possibility of the diaphragm having been penetrated. The patient being a male, the possibility of tubal insufflation can be ruled out. There had never been an attempt to produce a pneumoperitoneum. Considering, therefore, the history and physical finding, the possibility of the air having entered the peritoneal cavity from without, can be ruled out.

The patient, a white male, aged seventeen years, was admitted to the hospital February 23, 1930, complaining of mild aching pain in the lumbar region dating back four days. The pain was more severe on the left side and radiated around to the left abdomen. The day before admission he awoke with severe sharp pain and tenderness in the left abdomen and left kidney region. There was no nausea or

vomiting. Urination was difficult. The urine showed albumin and occasional red cells. White count 16,450. Blood pressure 130. On physical examination the abdominal muscles were not rigid, but there was a spasm over the left lumbar region, accompanied by extreme tenderness. The temperature was 103, pulse 120, and white cell count 19,000.

The patient was studied with the x-rays on February 24, 1930. A small area of increased radiability was encountered which was reported as gas between the liver and the diaphragm on the right side (Fig. 2).

The afternoon of February 24, 1930, Dr. Harry Culver explored the left kidney, not opening the peritoneal cavity. The kidney and ureters were said to be normal. The wound was closed and the patient put to bed. Following the operation the pain was not relieved. The white cell count was 22,000. The temperature dropped to 100.

On February 28, the patient was again submitted to x-ray study and a large amount of gas was seen under the diaphragm (Figs. 3 and 4). There had been a great increase since the former examination. We still insisted there was a ruptured hollow viscus. Physical examinations revealed about the same findings. There was some question regarding the rigidity of the abdomen. The chest examination for pathology was negative.

On March 1, 1930, the white cell count was 18,000. The abdomen was opened by Dr. H. E. Mock and, apart from the presence of some moderately enlarged lymph glands, no pathology was found. We believe it is fair in reporting this case to say that the surgeon did not take the stomach or the bowel out and inspect them. The stomach and bowel, however, were carefully palpated. We all know that a small ulcer may be present and not felt. Dr. Mock listened very carefully when the peritoneal cavity was opened, but heard no noise suspicious of the escape of gas. There was no evidence of a localized or generalized peritonitis.

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In regard to Dr. Mock we must say that he is a man of unquestioned surgical ability, and we are sure his examination was thorough,

than the fluoroscopic examination. This is especially true in small perforations with slow leakage. In the case reported, it is

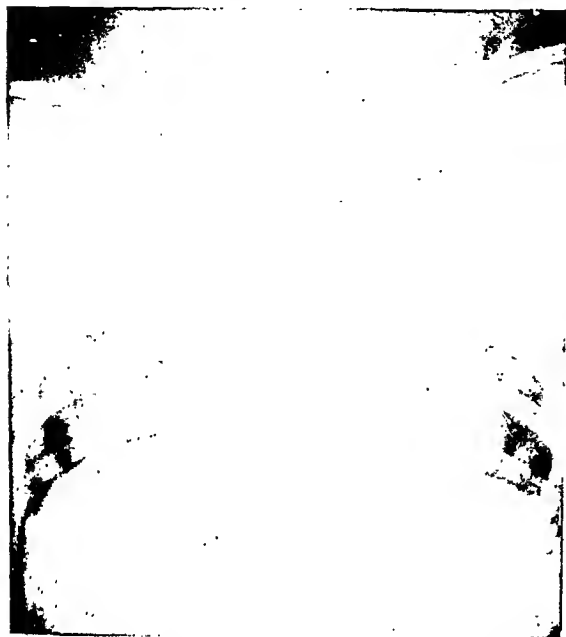


FIG. 1. Four months before abdominal symptoms developed. No evidence of gas under diaphragm.

especially when considering the patient's condition. The patient has had a myocarditis for years and at times the heart showed evidence of decompensating. Having a patient with an already damaged heart it certainly

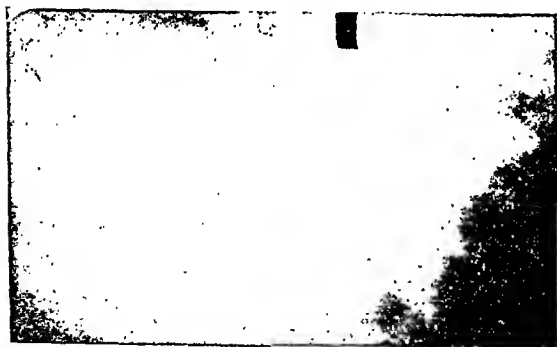


FIG. 2. February 24, 1930, showing gas under right diaphragm.

was for his best interest to get in and out of the abdomen as fast as was compatible with a careful exploration.

At this point, to digress, we wish to emphasize the fact that in our experience, the film diagnosis is of greater importance



FIG. 3. February 28, 1930, free gas under both domes of diaphragm.

relatively certain that the small amount of gas below the diaphragm in Fig. 2 would be very difficult, if not impossible to demonstrate fluoroscopically. The technic we employ requires that the patient lie on the left side for a period of time. This allows gas within the stomach to pass to the pyloric and duodenal regions and escape if possible. Films are then obtained with the patient in the sitting posture. A motor driven table is of distinct advantage as the patient may with very little disturbance be tipped sufficiently to allow the gas to rise below the diaphragm.

As to the gas under the diaphragm, we feel, and the accompanying prints show conclusively, that there was gas under the diaphragm. We are not interested in the finding as a matter of trying to prove the x-ray findings more accurate than the surgeon's examination with the abdomen open. On the contrary we are well aware of the limitations and the misinterpretations of all methods of examination. The presence of gas under the diaphragm can, we believe, mean only two things: either there has been a ruptured hollow viscus, or air has entered the peritoneal cavity

from without. In this case we believe we can definitely rule out the latter. We feel the finding is important and consequently

as a duodenal ulcer. There was no evidence of a penetrating lesion. There was fixation of the second and third parts of the duodenum. The



FIG. 4. February 28, 1930, free gas under both domes of diaphragm.

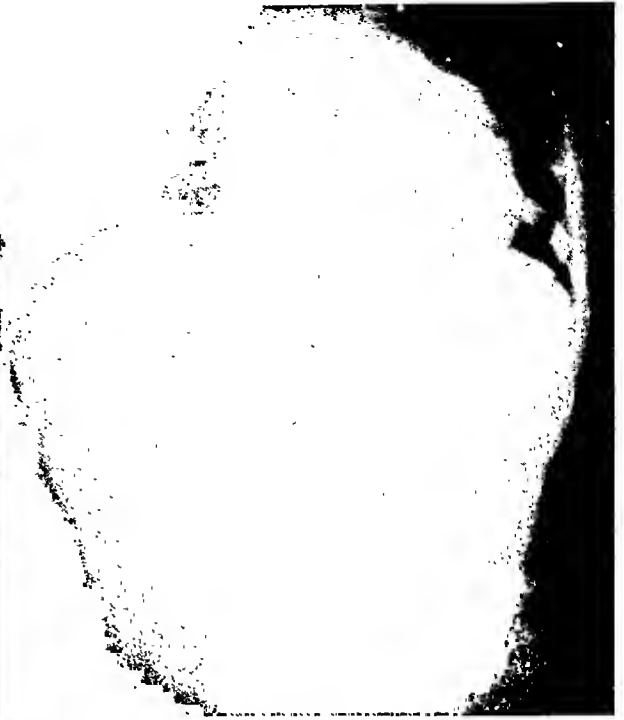


FIG. 5. March 19, 1930, eighteen days after laparotomy. No gas present under diaphragm.

have spent a great deal of time ruling out the possibility of air having entered from without.

This patient's chest was examined by means of the x-rays several months before the present examination. The chest films show the diaphragm and at this time no gas was seen under it (Fig. 1).

The first film of the abdomen made February 24, 1930 (Fig. 2) shows only a small amount of gas. The films made February 28, 1930 (Figs. 3 and 4) show a marked increase in the amount of gas. The spleen and liver can be definitely outlined and the gas is located under both domes of the diaphragm. During this time the patient's symptoms persisted.

Two days following the operation the temperature subsided and the patient gradually improved, the pain becoming less and finally subsided.

On March 19, 1930 (Fig. 5) the patient was again radiographed and no gas could be demonstrated under the diaphragm.

On April 5, 1930 a gastrointestinal x-ray examination was made and a deformed duodenal bulb was found which was interpreted

remainder of the gastrointestinal tract was normal.

Vaughn and Singer report cases termed abortive in which there may be a sudden severe onset and which later improve with disappearance of the symptoms. They believe these are cases of spontaneous closure of a perforation with small leakage. Patients with small perforations will show gas at times and yet heal spontaneously. We offer this as a suggestion: possibly the patient had a small perforated ulcer of the duodenum through which the gas escaped. Then the lesion was walled off by adhesions. The perforation was small and only a localized peritonitis followed.

In reviewing the literature we find a large number of cases in which gas below the diaphragm has been demonstrated in the roentgenogram and at operation a ruptured hollow viscus was found. Popper in 1915 first suggested that pneumoperitoneum occurred following perforation of gastric, duodenal and intestinal ulcers and

also, in perforative appendicitis and after injuries to the intestines.

Lenk in 1916, emphasised the significance of intraperitoneal free air in abdominal gunshot wounds and suggested radiological examination as valuable in the diagnosis of perforated peptic ulcer.

Numerous cases have been reported, including L. Kenez (1917), W. E. Dandy (1919), B. Bager (1920-1921), Schottmuller (1921), Cottle and Spaulding (1927), A. Guillemin, (1923), and R. T. Vaughn and W. A. Brans (1924); and (1925) also R. T. Vaughn and H. A. Singer (1929). Referring to the latter, 63 cases were examined shortly after admission with the

final diagnosis of perforated peptic ulcer. In 54 of the 63, evidence of pneumoperitoneum was found. The presence of the ulcer was proved by operation or autopsy in 49 of the patients with free intraperitoneal gas. The remaining 5 recovered spontaneously without operation, but subsequent radiographic examination revealed peptic ulcer with no other cause for the pneumoperitoneum. Of the 9 other cases there were 2 tuberculous ulcers of the small bowel, 2 typhoid ulcers, 3 perforated appendicitis, and 2 perforated carcinomas of the stomach. To summarize, all of the cases were due to ruptured air-containing viscus.

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\*Continued from p. 66.

# TREATMENT OF PEPTIC ULCER\*

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THE diagnosis and treatment of peptic ulcer date from the time of Cruveilhier early in the nineteenth century. Gastric physiology was not then well understood. It was known that hyperacidity existed in cases of peptic ulcer and the object of treatment therefore was to neutralize this acid, thereby reducing the irritation to the ulcer.

The motor functions of the stomach and the theories of secretory activity of the gastric mucosa were not taken into consideration because they were practically unknown. As a result of our increased knowledge of gastric functions the treatment of peptic ulcer has at last been based upon sound physiological principles.

Although the peptic ulcer means an anatomical defect within the gastric or duodenal wall, that in itself is not the reason that brings the patient to the doctor. Ulcers pathologically active and healed have been found on autopsy which have never been diagnosed in life. In fact, they caused very little inconvenience to the patient. It is only when the function of the gastrointestinal tract is disturbed that the patient becomes aware of the disturbance and the physician is able to diagnose the ulcer. Often the diagnosis must be made on the history and subjective symptoms as very few simple ulcers give early objective symptoms. Only when they begin to perforate or cause hemorrhage or induration which may be felt through a thin abdominal wall do objective symptoms appear.

The x-ray in itself will give direct evidence in about one-half of the cases. It will help the clinician who has studied the case thoroughly and has found certain indirect evidence to make the correct diagnosis.

A new method has lately been invented which may be of assistance in the study of

the gastric mucosa where the x-ray cannot give direct evidence. I refer to the gastrophotor instrument. By means of a camera at the end of a flexible stomach sound a number of films are exposed and stereoscopic pictures of the mucosa are made. This permits the study by visualization of the condition of the gastric mucosa. I have been successful in photographing a few ulcers on the posterior wall of the stomach and in a few cases have diagnosed chronic gastritis. In one case the gastrophotor picture showed a double ulcer which was not found by the surgeon at operation even after opening the stomach. The postmortem showed two shallow ulcers with marked induration.<sup>1</sup>

Keeping in mind that it is the disturbed function that the physician has to treat in peptic ulcer, we must understand something of the pathological physiology of this condition.

The fasting stomach is not absolutely quiet. Peristaltic waves appear at intervals of an hour to one and one-half hours. These waves which begin near the cardia are long and shallow, becoming shorter and deeper as they reach the pylorus where the walls are thicker.<sup>2</sup> After a meal, however, the peristaltic waves are greatly increased in frequency and in strength.

In peptic ulcer there is an interference with this orderly procedure. Because of the irritation set up by the ulcer there is an increased peristalsis often to the point of spasm. Where the ulcer is in the body of the stomach an incisura is often seen on the opposite side and where the ulcer is in the pyloric region spasm of the entire pylorus is often noted. This increased peristalsis sets up an increased motility of the entire gastrointestinal tract.

Toward the end of a meal, because of increased irritation, spasm of the pylorus supervenes with the result that a gastric

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and often duodenal residue is found at the end of six hours. Even an ulcer high in the gastric wall will often cause enough

extragastric pathology. The stomach is a very sensitive organ and any irritation of an organ even remotely connected with it

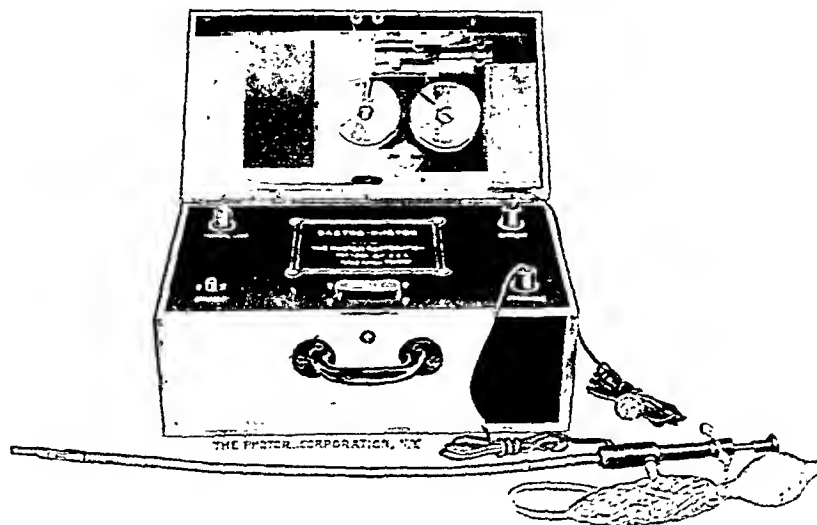


FIG. 1. Camera complete with transformer.

irritation to bring on pyloric spasm with the resultant gastric residue.

So-called hypersecretion and hyperacidity are purely the result of this pyloric spasm or pyloric stenosis. The normal gastric secretion is not evacuated and hence accumulates in the stomach and the normal regurgitation of the duodenal contents which neutralizes the gastric acidity is not present, hence the high acidity.

Even where there is an actual stenosis present due to the presence of an ulcer in the pyloric ring or cicatrization in this region, spasm is always present and there is enough evidence to show that the large dilated stomachs one sees in cases of chronic duodenal ulcer with cicatrization is due as much to the spasm of the pylorus as to the anatomical changes present.

Any undue or prolonged irritation in the gastrointestinal tract will through the vegetative nervous system cause disturbances in other organs and hence the neurosis and often cardiac symptoms accompanying gastric diseases.

In undertaking the treatment of peptic ulcer correct diagnosis must first be made. It has been estimated that about 90 per cent of all gastric complaints are due to

through the nervous system will throw the stomach into spasm. This is true of cholecystitis, appendicitis, colitis, prostatic conditions in men and gynecological conditions in women, or ordinary constipation.

Even the history is not always infallible. Hunger pain often occurs in other diseases. In 15 per cent of chronic cholecystitis and chronic appendicitis there is a typical history of hunger pain.<sup>3</sup>

When after a thorough examination and x-ray study there is some doubt as to the diagnosis belladonna should be given for a few days and the patient re-x-rayed before the final diagnosis is reported.

When a common ulcer is in a visible situation the most important part of its cure is to maintain that part in a state of complete rest to protect it from all kinds of irritation and eliminate so far as possible all conditions that interfere with healing. These conditions we would like to attain in the treatment of peptic ulcer. Unfortunately the position of the lesion precludes the possibility of complete rest to the organ involved. We can, however, decrease its action and give the organ a certain amount of rest, thereby permitting the ulcer to heal, though slowly.

The first thing to do then in instituting medical treatment in cases of peptic ulcer is to put the patient to bed at complete physical and mental rest. This in itself will slow up metabolism, reduce mental irritation, and thus give some amount of rest to the gastrointestinal tract.

Cruveilhier who first described the clinical picture and suggested treatment for gastric ulcer already recognized the necessity for rest. The English physicians of that time and later Ziemsen and Leube incorporated rest in bed for two weeks in their treatment of gastric ulcer. Lenhartz increased the amount of rest in bed to four weeks, recognizing that two weeks are not sufficient to cure a case of peptic ulcer. At the present time most authorities insist on at least four weeks of absolute rest in bed at the beginning of treatment for peptic ulcer. Plenty of sleep is important, as during sleep there appears to be a complete inhibition of gastric movements.<sup>4</sup>

Tobacco should be prohibited. It has been definitely shown that smoking will cause hypersecretion and pylorospasm,<sup>5</sup> thereby causing retention with its accompanying deleterious effects. Ninety-six per cent of males with duodenal ulcers are smokers, 60 per cent are heavy smokers.<sup>6</sup> The recent work of Gray on the "Gastric Response to Tobacco" is significant.<sup>7</sup>

Local applications of heat will aid in relaxing the gastric wall. Local heat will relax the walls of the internal hollow organs; cold will cause the increase of peristalsis.<sup>8</sup> Various forms of applications have been recommended. Hot solutions of equal parts of alcohol and water or hot boric acid solutions, dry heat in the form of a hot water bottle and an electric pad are all valuable. The wet packs seem to be preferred by many. Drinking large amounts of ice water should be prohibited. Cold drinks and very hot drinks will often cause increased peristalsis and even pylorospasm.

The most important part of the treatment of peptic ulcer is the diet. Since peptic ulcer was first recognized diet played an important part in its treatment. Cruveil-

hier suggested milk diet. No general plan existed until Leube and Ziemsen formulated their dietary plan. This was followed

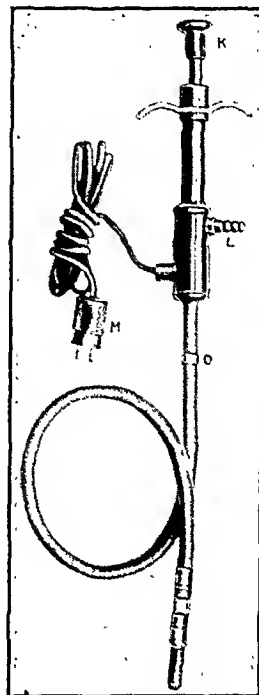


FIG. 2. The tubular portion.

for a number of years until Lenhartz in 1901 formulated a less strenuous diet consisting of eggs and milk for the first five or six days and then adding raw minced meat which was gradually increased until at the end of two months the patient was on a full diet. Senator later modified this diet by adding gelatine, fat and sugar, fresh butter and cream in small quantities. The Lenhartz diet was modified and Americanized by Dr. Harris who added meat and meat products much later in the treatment.

In 1915 Sippy reported a series of cases in which he claimed to have cured ulcers by a combination of diet and alkalies which became known as the Sippy treatment.<sup>9</sup> This form of treatment consists essentially of equal parts of milk and cream every hour from 7 A.M. to 7 P.M. together with one powder consisting of bismuth subnitrate and sodium bicarbonate alternated with one powder of calcium carbonate and sodium bicarbonate between meals. After a few days soft boiled eggs, cereals and vegetable purees are gradually

added. In cases of pyloric obstruction or spasm with accumulation of fluid during the night, the stomach is emptied by means of a stomach tube.

The advantages claimed for this method of treatment are that the gastric acidity is controlled and that in pyloric stenosis, the accumulated fluid is removed lessening the irritation. In addition, the patient gains weight by the increase in diet.

This treatment is not without its disadvantages for unless large doses of alkalis are given no change of acidity takes place.<sup>10</sup> Also it has been shown by Hardt and Rivers that excessive alkalization will lead to alkalosis which may prove to be a serious matter.<sup>11</sup> It must be remembered that the gastric mucosa is normally bathed in an acid medium and neutralization will only stimulate the glands to greater effort and more acid will be secreted. This process goes on till the cells are exhausted and only a mucous fluid is secreted in large quantities,<sup>12</sup> a condition which will retard healing of the ulcer.

Duodenal feeding as suggested by Dr. Max Einhorn is very valuable in the treatment of peptic ulcer, especially in cases of high grade irritation with spasm of the stomach walls. The tip of the tube is allowed to enter the second portion of the duodenum and a mixture of milk and eggs as used in the Lenhartz diet with enough of milk sugar to make up calories is injected very slowly, beginning with about 4 oz. every two hours and gradually increasing until the patient takes 8 oz. of this mixture every three hours. Needless to say, the mixture should be of body temperature and should be given very slowly with a syringe to prevent over-distention of the duodenum. Before every meal warm water should be driven through the tube to clean the fenestra in the tip of its mucus. After the meal the tube should be cleaned with a syringeful of warm water followed by air to prevent adherence of the food to the sides of the tube. The tube is kept in place permanently for

twelve to fourteen days and after removal the patient is put on the regular ulcer diet and treatment is continued as in the other methods. In many cases where the spasm and active peristalsis persist despite treatment, the Einhorn method will bring about almost immediate relief. The supposed objection that the continued presence of the tube will cause irritation is not a fact.<sup>13</sup>

Warren Coleman recently suggested a high fat, high caloric diet in cases of peptic ulcer. Dr. Coleman suggests preliminary treatment as in the other methods. No food is given for four days during which time 10 per cent glucose in normal saline is given per rectum. After the fourth day of fasting mouth feeding is commenced. The food consists of white of eggs and olive oil or butter fat. The white of egg and the fat should be given alternately every two hours. The first day 50 c.c. to 75 c.c. of oil are given and the whites of 3 eggs. This is gradually increased until 150 c.c. of the olive oil are given per day and from 6 to 8 whites of eggs. If the patient cannot take olive oil he may take butter fat, hot or cold, with the addition of a pinch of salt.

Dr. Anthony Bassler treats his patients with a modified Sippy diet. He also starts the treatment with fasting the patient from twenty-four to forty-eight hours. During this period he gives  $\frac{1}{4}$  gr. calomel every fifteen minutes for 8 doses followed by a dose of Carlsbad salts. Carlsbad salts are also given at twelve-hour intervals during the fasting period. He allows cool water during this fasting period to allay thirst. Ten grains each of sodium bicarbonate and bismuth subcarbonate are given every three hours during the day and every six hours during the night to alkalize the gastric acidity. A very important departure that he makes from the usual diets is that he does not allow meat or meat products until after the fourth month and very little of it then.

With the exception of the Einhorn form of treatment the other methods are

based upon the theory of neutralization of the gastric juice. Boldyreff and others have shown that fat will cause regurgitation of the duodenal contents into the stomach. The pancreatic and bile juices will split the fats even in the stomach. The resultant fatty acids are strong irritants and will not only stimulate the gastric mucosa to further activity but will undoubtedly irritate the ulcer. It must also be remembered that fats remain in the stomach longer than any other type of food and their mere presence will cause continued irritation. Therefore from a physiological standpoint Coleman's diet is not the ideal one. The high fat content of the Sippy diet will stand the same criticism, in addition to which is the objection of the attempted alkalization as already stated.

In view of these facts it would appear that the only dietary treatment in cases of peptic ulcer is one that will not stimulate the gastric secretion. The diet should consist of those foods which will leave the stomach rapidly and so give the least amount of irritation to the gastric mucosa.

Before discussing such treatment a few general principles should be mentioned:

1. All food stuffs give rise to more or less gastric secretion. Such very bland food as milk has been found to produce a high acid secretion.<sup>14</sup>

2. Carbohydrates leave the stomach more readily than the other foods. Next come proteins and lastly the fats.

3. The object of the treatment is to incite the least amount of activity on the part of the stomach both in peristalsis and secretion.

4. Before beginning treatment all foci of infection should be removed. The heart and kidneys should be thoroughly examined and taken care of. Neuroses are frequent and often hyperthyroidism is present and should be treated. If the hyperthyroidism is of the type that needs surgical intervention it should be done as soon as the proper preparations are made. It is interesting to see the ulcer symptoms lessen after thyroidectomy.

5. There is no ambulatory treatment for peptic ulcer during the first three or four weeks. If the patient has not been put at complete rest both mental and physical he has not received the proper medical care and cure should not be expected.

6. After the period of rest the patient should remain under treatment for at least two years.

7. There are four criteria that establish the cure of the ulcer:

- (a) Relief of symptoms.

- (b) Continued absence of occult blood in the stool.

- (c) No delay or break in the peristaltic wave as it passes down the stomach wall to the pylorus.

- (d) Disappearance of the defect as observed on the x-ray.

If the first three of these conditions obtain then the ulcer may be considered as healed. The defect as seen on the x-ray may remain but has probably taken on a different appearance.<sup>15</sup> With these fundamental ideas in mind, we may now proceed to describe the treatment itself.

The patient is put to bed for at least three weeks. In all cases of peptic ulcer the normal action of the colon is disturbed. This may be corrected by one dose of calomel and compound Jalop powder of each 5 grains.

Hot boric acid solution compresses are applied locally. The abdomen may be covered with a thin layer of vaseline or any other oil to prevent burning or chafing of the skin from these hot applications. This will relieve the gastric and pyloric spasms since as stated, heat applied locally produces relaxation of internal hollow viscera. Nothing is given by mouth for a period which varies from two to five days, as the severity of the symptoms dictates.<sup>16</sup> After two days of fasting the gastric secretion is at a minimum. During the fasting period rectal feedings are instituted. Solution of 5 per cent glucose in normal saline is given by Murphy drip. In this manner about 600 calories per day can be administered.



When oral feeding is begun small frequent meals are given which consist in the beginning of thin cereal gruels. As stated previously the gruel will leave the stomach rapidly and cause the least amount of secretion. Gradually and cautiously other foods are added until at the end of three weeks sufficient amount of food is given consisting of cereals, eggs, vegetable purees, zweibach and lactose. The nutrient enemata are continued during the first six days of treatment to increase the caloric intake.

The following is a sample diet as used in our clinic: (Note 1).

First five days:

Give 3 oz. thin watery gruel through glass feeding tube every two hours, beginning at 8 A.M. with last feeding at 8 P.M. Each day increase 1 oz. with each feeding.

6 to 8 days:

Give equal parts of parboiled milk and thin gruel.

9 to 11 days:

Add 2 oz. milk sugar to total quantity.

12 to 15 days:

6:30 A.M.

One teaspoonful sodium phosphate in hot water.

7:30 A.M.

Stewed fruit juices.

2 oz. cream of wheat, rice or farina.

2 oz. parboiled milk.

1 teaspoonful of milk sugar.

9:30 A.M.

6 oz. thin gruel water or vegetable puree.

1 teaspoonful milk sugar.

1 zweibach or toasted bread.

11:30 A.M.

4 oz. malted milk (parboiled milk used). Custard.

2 P.M.

6 oz. gruel with parboiled milk.

1 teaspoonful milk sugar.

1 zweibach.

5 P.M.

Vegetable jello.

6 oz. parboiled milk diluted.

8 P.M.

6 oz. malted milk.

3 Graham crackers.

16 to 21 days:

6:30 A.M.

1 teaspoonful sodium phosphate in hot water.

7:30 A.M.

Orange juice.

2 oz. cream of wheat, rice or farina.

2 oz. parboiled milk.

Add milk sugar in both.

9:30 A.M.

6 oz. vegetable puree.

1 zweibach.

11:30 A.M.

4 oz. malted milk, parboiled milk used. Custard.

1 P.M.

6 oz. vegetable puree.

2 oz. cooked rice, tapioca or corn-starch pudding made with milk and egg yolk.

2 oz. parboiled milk, milk sugar.

1 zweibach.

4 P.M.

6 oz. gruel.

1 soft boiled egg.

1 zweibach.

6 P.M.

Vegetable jello.

6 oz. malted milk with parboiled milk.

2 zweibach.

9 P.M.

1 soft boiled egg.

6 oz. thin gruel with milk.

2 zweibach.

Beginning with the fourth week the diet is increased to consist of well cooked cereals, vegetables in the form of potatoes, carrots and vegetable purees; white bread with plenty of butter, malted milk, plain milk, eggs, crackers and stewed fruits. Orange juice is added at the beginning of the third week. At the fifth week add tomato juice. Gradually cheese, macaroni and spaghetti are added to the diet. Meat, fish and their products and broths are not allowed for at least six to nine months and then very cautiously.

In cases of gastric hemorrhage the fasting period should be longer but the dietetic treatment is essentially the same. If the fasting period must be unusually long, in addition to rectal feedings glucose is administered intravenously and by hypodermoclysis, in this way supplying a certain amount of calories. At the beginning of this treatment the patient naturally loses weight but this, however, is soon regained, and at the end of six months we usually find the patient in better physical condition with a marked increase in weight. This can readily be understood when we figure the caloric value of the diet. At the beginning the patient is getting only 126 calories per day. There is a gradual increase until the sixteenth day when the patient receives about 1700 calories per day. Because of the small amount and concentrated food given the first fifteen days the bowels become obstipated. This can readily be taken care of by 1 tablespoonful of petrolagar (plain) given every night.

Within the past few years there has been a growing tendency to consider the lack of vitamins in the general diet as a cause, or at least a contributory cause for peptic ulcer. The statement has many times been made that peptic ulcer is rare in India, in certain portions of Russia, in the Rhone Valley and other places where the main articles of food consists of vegetables and dairy products. Is it not possible that the high vitamin and salt content of these foods prevent the formation of gastrointestinal ulcers?

The experiments of McCarrison in India and of McCollum at Johns Hopkins would tend to such a theory. Harris recently discussed this subject and asserted that the vitamins "B" and "C" are deficient in the average American diet.<sup>17</sup>

With these facts in mind orange juice and tomato juice are given rather early in the ulcer treatment, and the later diets are constructed to include foods containing plenty of vitamins.

Under this treatment very few drugs

are given. We have seldom been forced to resort to alkalies in any form to relieve hyperacidity. Where alkalies are indicated during the first day or two of the treatment to relieve pain and spasm the calcium and bismuth salts are administered because they act slowly and do not tend to increase gastric secretion.<sup>18-20</sup> Also belladonna is often given at the beginning of the treatment for the purpose of relieving spasm and for its possible effects in reducing secretion. It has been suggested that belladonna caused an increase in the leucoeytosis of the gastric contents and within the gastric wall, thereby promoting repair of the wound.<sup>21</sup>

Under this treatment recurrences do not happen frequently, mainly because the patient is kept under observation for a long time, at least from nine months to a year. This is a great factor in the subsequent treatment of peptic ulcer.

It is understood that during this period smoking is prohibited, strenuous exercises should be avoided, and plenty of rest and sleep should be encouraged.

It is commonly agreed upon that certain types of ulcer are amenable only to surgical treatment. These are:

1. Ulcers with repeated hemorrhages which will not yield to medical treatment.
2. Chronic callous ulcers that have undergone a number of medical treatments without permanent benefit.
3. Very large ulcers that present suspicion of malignant degeneration.
4. Deformities of the gastric walls.
5. Perforating or perforated ulcers.
6. Pyloric stenosis with definite twelve-hour retention that has not improved after a thorough medical treatment.

In the common uncomplicated type of ulcer, I believe, medical treatment is best and does more good.

As internists, however, we are also interested in the type of operation which our patient should be subjected to and I believe the surgeon should consult the physician in charge of the case to decide the type of operation for the particular

type of ulcer in question. Every operation is valuable in certain selected cases. Before operation is undertaken the patient should be treated medically, spasm should be allayed, secretions should be diminished, the general condition of the patient should be toned up. Save in an emergency the practice of operating on a patient within twenty-four hours after his admission to the hospital is not to his best interest and is often the cause of very grave results.

In cases of callous duodenal ulcers, pyloric stenosis or perforating ulcers which have not yet penetrated the peritoneal covering, the simple gastroenterostomy with or without pyloric occlusion offers the best chances to the patient. If perforation has occurred the opening should be closed and a gastroenterostomy performed.

Following gastroenterostomy, gastrojejunal ulcers occur anywhere in from 3 to 20 per cent of the cases depending upon the clinic reporting. Because of these marginal ulcers, subtotal gastrectomy has been advocated by many surgeons.

This operation, which apparently was first suggested by Kelling of Dresden, is based upon the questionable theory which supposes the elaboration of a hormone in the pyloric mucosa. This theory has been questioned by Carlson.<sup>22</sup> Furthermore, Ivy has proved that the mere distention of the stomach causes an increased gastric secretion.<sup>23</sup> But even if the hormone theory is true there are other ways in which the gastric secretions are stimulated. Through the nervous system secretion is stimulated by appetite, by visualization of food and by mere chewing. Some investigators have suggested that another hormone is formed in the small intestines which also stimulates gastric secretions.<sup>24</sup> In a number of cases in which more than one-half of the stomach has been resected we have found free acid varying from the normal to hyperacidity after an ordinary meal.

Schiassi has recently recommended the cutting of the left vagus to prevent the nerve action on the gastric mucosa.<sup>25</sup> This does not seem to take into account the

physiology of the stomach. If the part of the stomach containing the acid secretory cells is still present then acid gastric juice will be secreted through stimulation by the hormone elaborated in the jejunum. The right vagus still sends fibers to the posterior wall of the stomach and is capable of stimulating gastric secretion. Experiments with histamin proved the presence of free HCL up to the value of 100 units after vagectomy.<sup>26</sup>

Another important factor to be considered by the surgeon and internist is the fact that gastric surgery, especially resection, is a very delicate operation and should be done only by experts, and where such expert is not available a much simpler operation should be performed.

The main advantages given by surgeons in favor of subtotal gastrectomy are:

1. Elimination of marginal ulcers.
2. Removal of the ulcer-bearing area.
3. Reduction of acidity.

These are more than offset by the many disadvantages of this operation.

1. The acidity is not always reduced by subtotal gastrectomy.

2. Complete achylia can only be produced and the entire ulcer-bearing area can only be removed by the removal of the whole stomach.

3. Even in subtotal gastrectomies, the literature is full of cases of resulting marginal ulcers.

4. A very mutilating operation has been performed, and the physiological conditions are worse than after a gastroenterostomy.

5. No chance is given for the ulcer to heal and thereby make it possible to restore the stomach to normal conditions as may be done if desirable after a simple gastroenterostomy.

6. Patients after subtotal gastrectomy cannot hold much food in their stomachs and are forced to eat more often. Observation has shown that as a rule they tire easily and are not in as good health as those patients who have had only gastroenterostomy performed.

7. When marginal ulcers develop after a subtotal gastrectomy the only thing left to do is to resect the entire stomach. Cases are on record where three or four operations were performed on the same patient, each time removing more of the stomach until after the last operation no stomach was left. This is surely not the ideal treatment for peptic ulcer.

8. With the removal of the stomach or where achylia has followed subtotal gastrectomy the acid antiseptic barrier in the stomach has been removed, making possible various infections and a possible development of pernicious anemia.

9. In cases of gastric resection no thought is given to the possible effect on the kidneys by the added burden of excreting the large amount of acid radicles which would otherwise have been excreted by the stomach as hydrochloric acid.

10. It is claimed that a patient with a peptic ulcer is more apt to die after a gastric resection than to develop a peptic ulcer after a gastroenterostomy.<sup>27</sup>

11. The mortality is three times as great as after gastroenterostomy.<sup>28</sup>

Most of the patients suffering from marginal ulcers are those patients who had practically no treatment subsequent to the operation. It is unfortunate that many surgeons simply operate on the patient and tell him that he is cured. Dr. Mayo has aptly stated that every patient having peptic ulcer should be treated for at least two years after being operated upon, no matter what type of operation has been performed and this dictum is well borne out by the fact that most cases of marginal ulcer appear within two years after the operation. (Note 2.)

Certain types of gastric deformities and suspected carcinoma can only be

relieved by gastrectomy. In these cases gastrectomy is not an operation of choice but of necessity.

Finally, if we could educate our patients suffering from any form of gastric disturbance, especially peptic ulcer, to remain under treatment for at least two years even after operation there would be fewer recurrences of gastric diseases. When a patient discovers that he has some disease of the heart he will take care of himself for the remainder of his natural life. Those suffering from gastrointestinal diseases, however, refuse to be under treatment longer than necessary to allay their discomfort. Only persistent effort and education will correct this attitude. Men and women will learn that the peptic ulcer remains although the symptoms have temporarily disappeared and that only by careful attention to diet and habits and sufficient amount of rest and sleep can they keep well. When this will be fully understood then we will have fewer recurrent ulcers to treat.

#### NOTES

1. Taken from the Gastroenterologic Department of the Brownsville and East New York Hospital. This diet was first suggested by Dr. Smithies of Chicago<sup>29</sup> and has been modified somewhat to suit the needs of our patients.

2. Since this article was written F. Gregory Connell described a new principle in the surgical treatment of peptic ulcer which he calls fundusectomy. In the usual cases of subtotal gastrectomy the acid secreting area is left. In fundusectomy this area is removed and the pylorus remains. I believe it is an interesting idea and should be further investigated.<sup>30</sup>

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\* Continued from p. 83.

# ALCOHOL INJECTION OF NERVE ROOTS FOR THROMBO-ANGIITIS OBLITERANS

PRELIMINARY REPORT OF 3 CASES DEFINITELY IMPROVED\*

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NEW YORK

SEVERAL methods of treating spastic conditions of blood vessels by surgical means have been described. These include periarterial sympathectomy, resection or excision of sympathetic ganglia and nerves, and alcohol injections into the sheaths of blood vessels. The object in these procedures is to paralyze or remove the vasoconstrictor innervation of the vessel walls, and thereby cause dilatation.

Similar methods have been applied in cases of thromboangiitis obliterans, in the hope of obtaining some degree of relaxation of the arteries, and so induce a proportionate increase in the blood supply of the extremities.

I have treated with satisfactory results, 3 cases of thromboangiitis obliterans by blocking, by means of alcohol injections, some of the efferent fibers which go to the lumbar sympathetic ganglia, and which in turn supply the vessels of the lower extremity. At the same time, some of the vasomotor fibers travelling in the genitofemoral, femoral and obturator nerves, (somatic nerves) are also blocked by the procedure.

In 1836, Goering described branches of the femoral and saphenous nerves supplying the femoral artery.

In 1874, Frey stated that peripheral arteries and veins are supplied by branches of the nerve trunks which lie closest to them.

According to Kuntz,<sup>1</sup> "the plexus of the abdominal aorta gives rise to a subordinate plexus on the common iliac artery, from which some fibers extend to the proximal portion of the femoral artery, but the more distal portions of the femoral artery and the other vessels of the lower extrem-

ity . . . are supplied by sympathetic fibers which are conveyed distally in the somatic nerves (Potts, 1915)."

Periarterial sympathectomy has demonstrated that long fibers, presumably coming from the plexuses on the aorta and its branches or the sympathetic trunk, extend distally in the adventitia of the peripheral arteries, and play an important rôle in the innervation of the peripheral portions of the arteries.

Hirsch (1925) demonstrated that these long fibers are not present in any considerable number, but that the peripheral vessels are supplied by branches from adjacent nerves at intervals along their course. He was unable to find a plexus even on the common iliac artery which might be regarded as an extension of the plexus on the aorta. He regularly found but few fibers extending along the common iliac artery from the aortic plexus, and only a minor portion of these fibers became definitely related to the artery. As soon as the genitofemoral nerve comes into close proximity to the external iliac artery, it supplies branches to the latter.

Kerper (1927) found that extirpation of the sympathetic trunk from the fourth lumbar to the first sacral ganglion inclusive, in the dog, does not deprive the hind limb of all sympathetic fibers. Some are supplied from the second and third sacral ganglia.

Preparations of the femoral artery in an animal which had both section of the roots of the spinal nerves supplying the hind limb, and extirpation of the lumbar sympathetic trunk, were entirely devoid of nerve fibers.

According to Woollard (1928), long

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fibers which extend distally along the brachial and femoral arteries play no important part in the innervation of the distal portion of these arteries and their branches.

Kuntz states that "extirpation of the second, third, and fourth lumbar sympathetic ganglia, or section of the communicating rami joining the nerves of the lumbosacral plexus must result in complete sympathetic denervation of the vessels of the lower extremity." I believe that fibers in the rami from the twelfth thoracic and first lumbar nerves also go to the aortic plexus, and from there, to the vessels of the lower extremity.

According to Gray<sup>2</sup>:

The abdominal portion of the sympathetic trunk is situated in front of the vertebral column, along the medial margin of the psoas major. It consists usually of four lumbar ganglia, connected together by interganglionic cords. It is continuous above with the thoracic portion beneath the medial lumbocostal arch, and below with the pelvic portion behind the common iliac artery. The ganglia are of small size, and placed much nearer the median line than are the thoracic ganglia. Gray rami communicantes pass from all the ganglia to the lumbar spinal nerves. The first and second, and sometimes the third, lumbar nerves send white rami communicantes to the corresponding ganglia. The rami communicantes are of considerable length, and accompany the lumbar arteries around the sides of the bodies of the vertebrae, passing beneath the fibrous arches from which some of the fibers of the psoas major arise. Of the branches of distribution, some pass in front of the aorta, and join the aortic plexus; others descend in front of the common iliac arteries, and assist in forming the hypogastric plexus.

Any procedure which alleviates the extreme pain, or postpones amputation, or permits it to be done at a lower level, because of vasodilation following paralysis of vasoconstrictor fibers, is worthy of consideration.

The procedure employed by me for the first time, I believe, consists of injecting 8 c.c. of 95 per cent alcohol into the nerve

roots of the twelfth thoracic, first and second lumbar nerves. It is impossible to pick out only the sympathetic fibers as they course through their rami. It is also impossible to pick out the fibers in the genitofemoral, femoral, and obturator nerves which supply the external iliac, femoral, and popliteal vessels. Therefore, some somatic fibers must be sacrificed. These fibers are of no tremendous importance, they being mostly sensory in character. In 2 cases injected by me, neither had any noticeable weakness of any muscles; the third case developed a slight weakness of the right lower quadrant muscles.

I particularly avoid the third and fourth lumbar roots, because of the possible paralysis of the quadriceps femoris through blocking the greater portion of the femoral nerve. The femoral nerve comes from the second, third, and fourth lumbar nerves, but the component coming from the second, I have found, may be separated from the main femoral nerve, and traced to the walls of the femoral artery.

The genitofemoral nerve, arising from the first and second lumbar nerves, is paralyzed, so that fibers to or from the external iliac and femoral arteries which this nerve supplies, are interrupted. These fibers are probably both afferent and efferent in character, as well as those in other somatic nerves supplying blood vessels.

The obturator nerve, arising from the second, third, and fourth lumbar nerves, sends some fibers to the femoral and popliteal arteries, so that blocking of the second probably interrupts some of these fibers.

Figure 1 is a plan of the lumbar plexus, showing the branches blocked by my method. It will be seen that by blocking the twelfth thoracic, and first and second lumbar roots, no very important structures are paralyzed, while the main efferent sympathetic fibers to the aortic plexus (and lower extremity) are affected. Besides, those fibers in the genitofemoral nerve to the external iliac and femoral arteries,

those fibers in the femoral nerve to the femoral artery, and some fibers in the obturator nerve to the femoral and pop-

ing loss of all forms of sensation over these areas, except deep pressure. This loss of sensation is not bothersome to the patient.

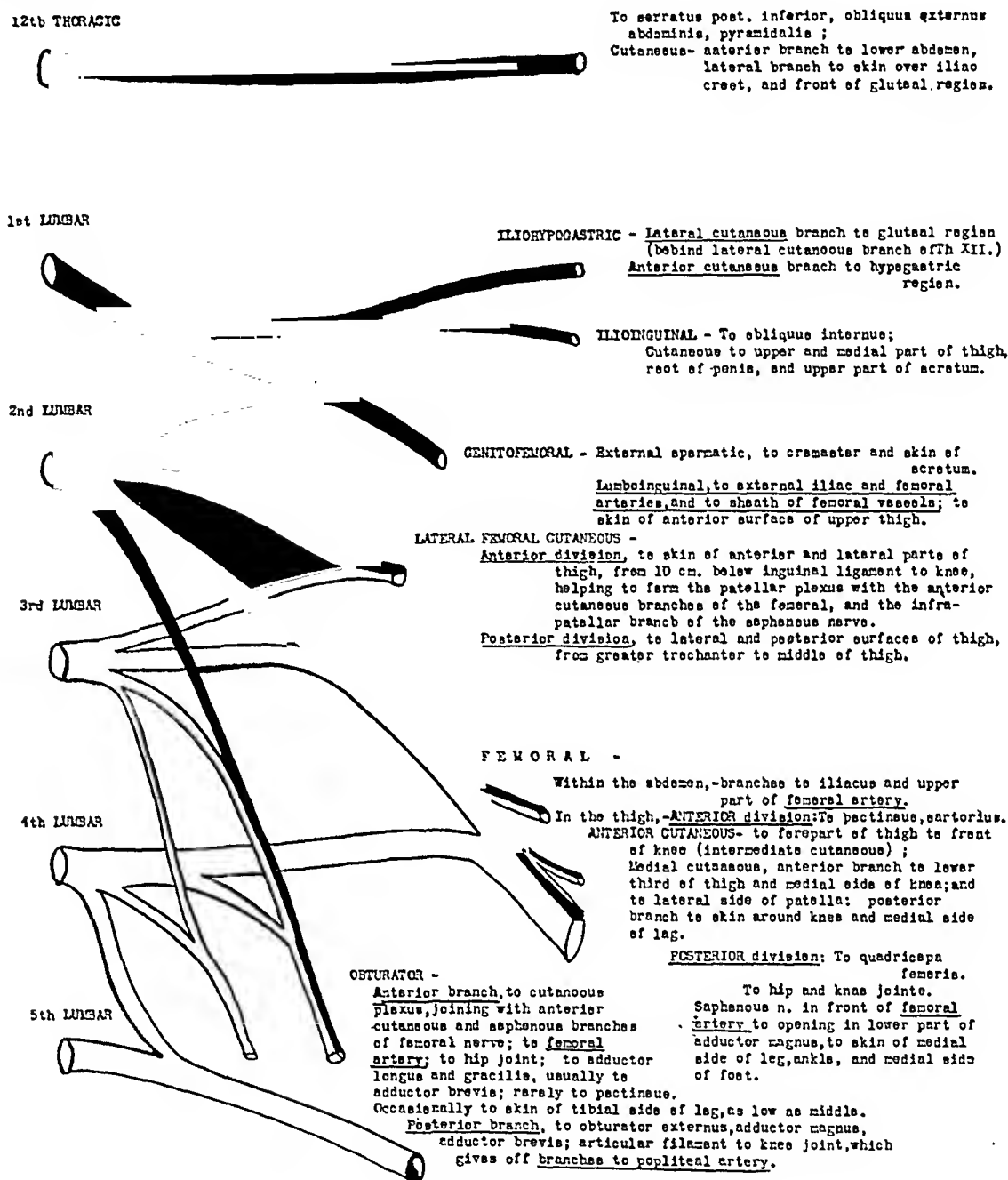


FIG. 1. Nerves affected by blocking the twelfth thoracic, first and second lumbar nerve roots with alcohol.

liteal arteries, are paralyzed. This combined action explains the increased blood supply to the lower extremity following blocking of the twelfth thoracic, first and second lumbar nerve roots, and their sympathetic rami communicantes.

Figures 2 and 3 show the skin areas affected by blocking the twelfth thoracic, first and second lumbar nerve roots, caus-

The results reported herewith are encouraging, but no one can state how long these good results will last. The simple procedure of injecting alcohol is less formidable than a sympathectomy or ganglionectomy, and may therefore be repeated at intervals, if necessary.

I have injected the stellate and upper thoracic sympathetic ganglia and thoracic



nerve roots with alcohol for the relief of pain in cancer and in angina pectoris. An increase in the circulation of the upper

his right foot three years ago, which is now healed.

*Family History:* Mother died of Bright's

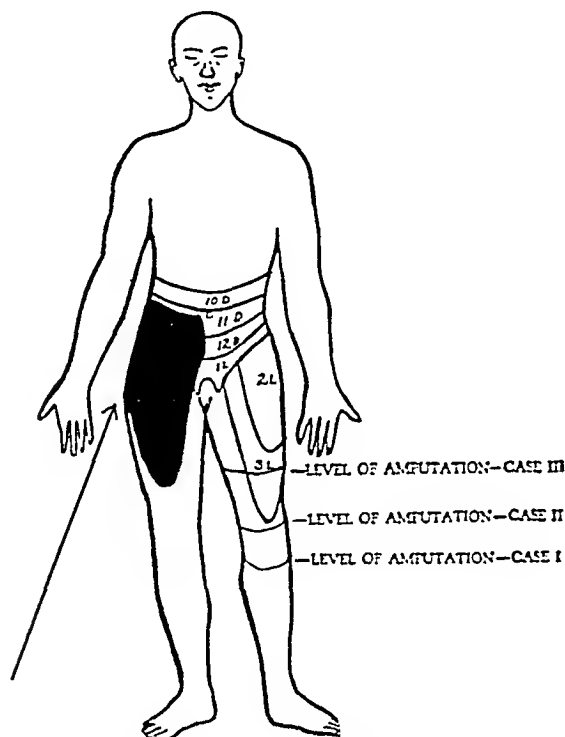


FIG. 2. Surface area affected by injecting the twelfth thoracic, and first and second lumbar nerve roots with alcohol. Front.

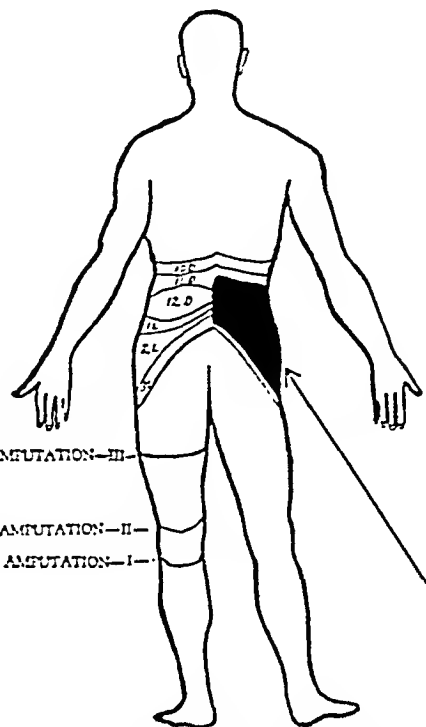


FIG. 3. Surface area affected by injecting the twelfth thoracic and first and second lumbar nerve roots with alcohol. Back.

extremity followed. This procedure may therefore be used instead of sympathectomy or ganglionectomy, in cases of vascular diseases of the upper extremity, such as Raynaud's disease and thrombo-angiitis obliterans.

*CASE I.* Mr. H. Z., white, Jewish, age fifty-five years, divorced; born in Paris, France, 1875, was referred to me on February 26, 1930. He complained of his right foot and toes feeling numb after walking three blocks. This, he noticed, was worse in rainy weather. He also complained of his entire right lower extremity being cold every morning, and his right foot being constantly cold.

*Past History:* He had dry pleurisy, and gonorrhea at sixteen (1891). Blood Wassermann test taken several times was always negative. He has had frequent bronchial colds, and influenza at the age of thirty-six (1905). He has had a cataract of the left eye for the past sixteen years. He fractured the big toe of

disease at 45 years of age. Father suffered with rheumatism after the Franco-Prussian War, and died of abscess of the brain at the age of fifty-two years. Three sisters and two brothers living and well; one sister has rectal trouble; one sister died recently of cancer of the breast; another sister died of dropsy at forty-eight years of age. Two brothers died at birth. No history of tuberculosis or insanity in family. Mother's sisters all have diabetes.

*Personal History:* Has been a real-estate salesman, but has not worked for the past five years. Appetite is good; sleeps poorly. No nocturia. Bowels regular. Has gained 15 lb. in two months. Does not drink any water during the day; three glasses of milk, two cups of coffee, one glass of tea each day.

Up to four months ago, he used to smoke a few packs of cigarettes each day; now he smokes from 8 to 10 cigarettes a day. He also used to smoke cigars and a pipe, but has given them up.

Does not indulge in alcohol. Takes no sleeping powders or other drugs now.

Since he was sixteen years old, and for thirty-eight successive years, he has had the morphine drug habit. He was cured of this habit at the time his left leg was amputated seventeen years ago, but following the operation, he resumed the habit up to a short time ago.

Recently, he has been bothered with gas, and a gastrointestinal series revealed a possible ulcer on the lesser curvature of the stomach, and findings suggestive of a chronic inflammatory condition of the appendix.

**Present Illness:** In 1906, at the age of thirty-one years, the patient was suddenly paralyzed below the nipples on both sides. He lost all power of his lower limbs, but was able to get around on crutches for three months. This paralysis cleared up. In 1907, he had what was diagnosed at the time as sciatic rheumatism, and continued to suffer with this condition up to the time his left leg was amputated in 1913.

In March, 1912, he had an infection between the fourth and fifth toes of his left foot, on what appeared to be a small scratch. This was probed, and three days later his leg "went dead." His fifth toe became gangrenous and was removed by a local physician. Ten weeks after this, his second, third and fourth toes "went dead," and they were amputated by another physician. He was taken to the King's County Hospital where in February, 1913, his left leg was amputated below the knee for gangrene. At no time did he ever have diabetes, and his case was diagnosed after the amputation as thrombo-angiitis obliterans.

His stump has not been particularly painful, but occasionally he feels the toes, and sometimes he has burning sensations at the end of his stump.

During the past five years, his right lower limb has always been cold, particularly in the morning, and his right foot and toes have felt numb, especially after walking a short distance. His right foot has always been cold, and from the start of his illness, he has always had a cold area on the upper anterior part of his right thigh.

The patient fears another amputation, and has vowed "to jump off the bridge" if this becomes necessary. Recently his hands have also become cold.

**Physical Examination:** Revealed an adult male who looked younger than his age. His body is fairly well nourished, but he appeared anxious and worried about his foot. He wears

an artificial limb on his left thigh. General condition, heart and lungs are normal. He has a somewhat ptosed abdomen, with considerable



FIG. 4. Case 1. A. Note amputation of left leg below knee, artificial limb, discoloration right leg and foot. B. Wearing an artificial limb; the right foot is threatened with gangrene, which would have required a similar amputation.

gas in his intestines. Blood pressure, right arm, sitting, 112/68; left arm, 100/58. Pulse at left wrist was not palpable.

**Condition of Extremities:** The right lower extremity below his knee was unquestionably cold to touch. The toes, with his leg dependent, assumed a slight purplish hue, which disappeared quickly when the leg was put in a horizontal position. The dorsalis pedis, posterior tibial, and popliteal pulses were not palpable. When he raised the right lower limb, the small veins on the dorsum of his foot emptied immediately. On placing the leg back to a horizontal position, it took three minutes for the veins to fill up, and even then, they were only partially distended.

The stump on the left side was slightly cyanosed, and also felt definitely cold to the touch.

Both hands were cold, and slightly cyanosed.

X-rays of his right lower extremity showed no thickening or increase in density of the vessel walls opaque to x-rays.

## PROCEDURE

On March 1, 1930, at 9:30 A.M., 8 c.c. of 95 per cent alcohol containing 25 per cent NaI

When seen on March 2 and 3, his foot and leg were still warm; the veins of his foot were well injected, and filled up rapidly after his leg

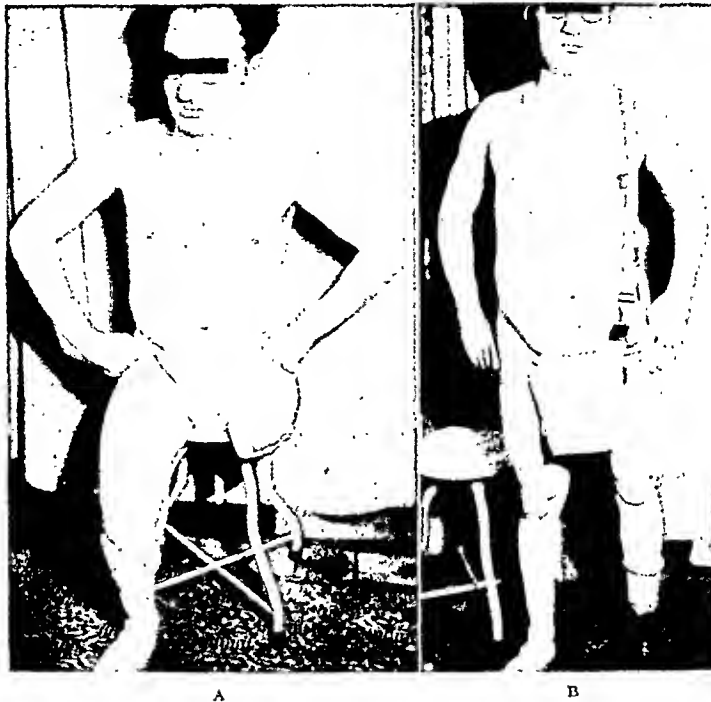


FIG. 5, Case II. A. Note amputation above left knee. B. Wearing an artificial limb; right foot similarly threatened with gangrene.

for x-ray purposes, were injected into the nerve roots of the twelfth thoracic, first and second lumbar nerves on the right side, after anesthetizing with 2 per cent novocaine. The first injection was quite painful, but this can be obviated by using larger quantities of novocaine than the  $1\frac{1}{2}$  c.c. used. The second and third injections were not painful, although the same amount of novocaine was used just prior to injecting the alcohol.

At 4 P.M. he complained of feeling weak, but had no pain. His blood pressure had dropped to 90/45, and stimulating drinks were ordered. He said he felt "life in the toes of the right foot," and his toes felt warm. He stated that no matter how many blankets he used to use, his toes were always cold. Now they were warm, and he was very much elated. Even his left stump felt warm, which suggests the crossing over of sympathetic fibers in the aortic plexus. No dorsal pedis or posterior tibial pulse was palpable.

The patient stayed in bed for twenty-four hours, and was then able to walk about, although he had some stiffness of his back.

was held up. He was much surprised to find that his limb was still warm, which showed that the circulation of the foot had been improved.

Sensory tests showed a loss of sensation to touch, pain, and temperature over the areas diagrammatically outlined in Figs. 2 and 3 but at no time did he complain of this, for he was told prior to the injections that this condition would follow. The right lower rectus and cremasteric reflexes were lost.

His right leg and foot have remained warm to date; in fact, his foot is so warm, that he has had occasion to sleep at night without any blankets on his foot!

**CASE IV.** Mr. M. L., white, Jewish, aged thirty-eight years, married; born in Kovna, Russia; was referred to me on March 20, 1930. He complained of his right foot being cold.

**Past History:** Nine years ago, he had what was then suspected as being typhoid fever, but blood tests for this disease were negative. He was sick for about four weeks at this time. A year and a half ago, he had a cold in his nose

for three months, and had headaches and discharge from his nose. He was operated upon for nasal polyps, and an impacted tooth was removed. For the past twelve years, he has had impaired vision in the left eye, so that now he has only 10 per cent vision left, and he was told that this was probably due to his condition. The patient never had diabetes, nor any other serious illness, but has had frequent nose bleeds.

*Family History:* Mother died at fifty-eight years of rheumatism of the heart. Father died at fifty-eight years of starvation. He has three sisters living and well, except for one who has gallstones. One brother died at three weeks of age, from hemorrhage following circumcision. One sister died at two years of age of starvation, and one at five years of measles.

His wife is living and is in fair health, having to work to support the family. She has had no miscarriages.

His wife's sister has tuberculosis, and her father and sister both have asthma. A first cousin on his mother's side has diabetes. There is no history of cancer or insanity in the family.

*Personal History:* Occupation, operator; has been unable to work for the past three years.

His appetite is fairly good; he sleeps fairly well; no nocturia; bowels are regular. He has gained 6 lb. in the last year. He drinks 3 to 4 glasses of water only after he gets a saline injection. Drinks no milk, but has 1 to 2 cups of coffee, and 1 to 2 glasses of tea a day.

He started to smoke at twelve years of age, continued for a few months, and then stopped. When he became thirty years old, after his present illness started, he smoked 12 to 15 cigarettes a day, for six years. For the past two years, he has not smoked at all.

For the past three months, he has had itching of his skin following injections of saline.

*Present Illness:* Seven years ago, in 1923, the patient's knees began to hurt him, and he was treated for flat feet by several doctors. During this time, his left foot was frost-bitten, and he developed a crack between his toes which took eight months to heal. He believes a tight bandage which was used to raise his flat feet started his trouble.

At the Long Island College Hospital he was told there was nothing to do until his leg would have to be amputated. Then a sore in the big toe of his left foot developed, and this healed after he took the "fasting treatment." Following this, he developed a sore between his fourth and fifth toes of the left foot, whereupon he

was treated at the Hospital for Joint Diseases for fifteen weeks with x-ray and sunlight therapy. The wound healed up, but then reopened and took nine months to heal. He was also treated with baking and diathermy, and he received between 50 and 60 saline injections during the past three years, without any improvement, at the Mt. Sinai, and other hospitals.

About three years ago, his left foot became gangrenous, and after a few weeks, he was advised to have an amputation. Another physician advised a solution in which to soak his foot, and gave him some pills. He was only slightly relieved, and so went to the Lebanon Hospital, where his leg was amputated above the knee. The stump healed well, and he has had only occasional pain in the stump recently.

For the past two years he has been getting intravenous saline injections three times a week, at the Mt. Sinai Hospital, without any improvement at all. His right lower extremity always remained cold. This patient likewise has threatened suicide if he has to ever lose his right leg.

*Physical Examination:* Revealed an adult male, well nourished and developed, about forty years of age; wears an artificial limb on the left side. General conditions, heart and lungs normal. Blood pressure 100/68 in both arms, patient reclining.

*Condition of Extremities:* The right foot was slightly cyanotic, the toes being a bluish purple with the leg dependent. An erythematous area with crimson red spots was on the outer and posterior aspect of his right thigh. A scar  $1\frac{1}{2} \times 1$  cm. was seen on the dorsum of his right foot, between the fourth and fifth metatarsal bones, the result of an infection in childhood. An area of hyperkeratosis was found to cover the under surface of his heel. Another area over the lower half of his right leg, especially in front, was entirely devoid of hair, as compared with a goodly growth of hair on the rest of the limb.

The right foot and toes were definitely colder to touch than the rest of his body, and this cold area extended to the upper part of his leg. No dorsalis pedis, posterior-tibial, or popliteal pulse could be felt. Both femoral pulses were palpable.

The stump on the left side was also cold to touch.

Both hands were warm, slightly moist, and of good color. Both radial pulses were palpable at the wrists.

## PROCEDURE

At 9.30 A.M. on March 22, 1930, 8 c.c. of alcohol and 25 per cent NaI were injected into

remained blanched on an erythematous base. This was probably due to a local reflex spasm of the capillaries of the skin, whose extrinsic



A



B

each of the twelfth thoracic, and first and second lumbar nerve roots on the right side. Each injection was preceded by 2 c.c. of 2 per cent novocaine. The first was quite painful, but the second and third were hardly felt at all. He complained of feeling weak, and his blood pressure dropped from 112 to 100, but after 1 c.c. of ephedrine was given, it rose to 120.

At 1.30 P.M. the patient complained of feeling weak, and he vomited; his blood pressure dropped to 80/60. Another 1 c.c. of ephedrine was given, and he was put into shock position. His foot at this time was warm. When seen again at 6.45 P.M. that evening, his foot was "as warm as toast," and he was feeling better.

At 2 A.M. the next morning, he vomited after taking a grain of codeine by mouth for restlessness, and at 4 A.M. he fell asleep after a sterile hypodermic.

When seen the following morning, his foot and leg were still warm. Skin tests showed a loss of all forms of superficial sensation over areas similar to those shown in Figs. 2 and 3 except that the area of anesthesia did not extend quite so far down on the front of the thigh. At this time, a persistent dermatographia lasting about twelve minutes, could be induced on the right side of his abdomen. This type of dermatographia was a blanched line which



C

FIG. 6, Case III. A. Amputation above left knee. Arrow points to bulging of lower right quadrant muscles after injections. B. Three dots show site of injections. C. Stump of right foot, threatened with gangrene.

sympathetic nerve supply had been affected by the injections.

The right lower abdominal reflex was absent; the cremasterics were present.

On March 3 two days after the injections, the patient felt "a strong tingling sensation extending from his knee downwards across the

dorsum of the foot, which was rather pleasant." This tingling sensation was accompanied by a "glowing feeling." This lasted a few minutes, and then returned near the ankle, and from behind the ankle, radiated to the sole of his foot. That evening he experienced a similar sensation on the bottom of his foot. These peculiar sensations might have been due to a relative opening-up of his blood vessels.

When he was seen again on March 7 seven days after the injections, I asked him whether his foot was still warm, and he replied, "That's assumed." His foot and leg have remained warm ever since, but he still sleeps with a woolen sock on his foot. Although I instructed him to leave it off, he has acquired the habit over a number of years of sleeping with it on, so that to sleep with it off annoyed him. He could not fall asleep until the sock was put on again.

The very first symptom of his illness, a cold feeling, or "freezing" as he describes it, in the anterior part of his upper thigh has disappeared completely.

On March 27 he noticed for the first time that his foot was not so blue in taking off his sock, but assumed a more pinkish rather than purplish hue.

The veins in the dorsum of his foot are fuller than prior to the injections.

No pulses have been felt in his foot, but the foot remains warm. When other members of his household complained of being cold, he felt warm, whereas *he* "used to be the cold one."

CASE III. S. W., forty-four years old, Jewish, born in Galicia, Russia, was an operator. At the age of thirty-four years he first began to have pains in the bottom of his left foot and in his left calf. After he had received intravenous saline injections for three months, an infection started in the big toe. The condition of the extremity got worse, and this led up to an amputation two years later.

Three years following this, he began to have pains in his right calf, and he suffered agony for one and one-half years. Then the big toe of his right foot started to get black. He received various treatments under different physicians well known in this specialty, and was about to have a similar amputation when his toes sloughed off. The wound has taken about two years to heal. He has had a constant coldness of his right lower limb, and has had frequent pains in his calf.

A similar procedure was carried out with this man, as was with the first 2 cases. He stood the injections very well, hardly having any pain at all. A few hours after the injections, there was a definite improvement in the circulation of the limb, as evidenced by a distinct warmth of the skin surface, especially around the stump of the foot. This improvement has persisted. In this case, however, the patient several days after the injections, complained of a slight weakness in flexing his right thigh, and also noticed a slight bulging caused by a weakness of his lower right quadrant muscles. However, this caused him no inconvenience, and this case substantiates the belief that the procedure is of real value.

#### SUMMARY

1. Blocking the right twelfth thoracic, first and second lumbar nerve roots with alcohol definitely increased the circulation of the right lower extremity in 3 cases of thrombo-angiitis obliterans.

2. This procedure blocks both the sympathetic fibers in the rami communicantes at these levels, as well as the vasomotor fibers in the genitofemoral, femoral, and part of the obturator nerves (somatic). These fibers innervate the aorta, common iliac, external iliac, femoral, and popliteal arteries, and possibly other terminal arteries in the leg and foot.

3. Blocking of somatic muscular and sensory branches of nerves arising from the twelfth thoracic, first and second lumbar roots, produced no serious paresis or paralysis of any muscles, nor any unbearable disturbance in the skin areas supplied by these nerves.

4. The good results obtained from this procedure may be explained as being due to an increase in the circulation of the lower extremity, caused by the removal of an appreciable vasoconstriction status which exists in this disease, either in the diseased vessels themselves, in those not diseased, or in both diseased and non-diseased vessels.

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# PRESENT STATUS OF ELECTROSURGERY AND DIATHERMY

## IN THE TREATMENT OF DISEASES OF THE GENITOURINARY TRACT\*

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DES MOINES, IOWA

THE part played by diathermy as a therapeutic agent in the treatment of diseases of the genitourinary tract is not fully appreciated by many members of the profession. This skeptical attitude taken by many of our colleagues can be attributed to three principal facts:

1. The enthusiastic remarks made by representatives of various manufacturing concerns who extol the merit of their machines with superlative claims not based on scientific data.

2. Premature conclusions reported by many investigators which have not stood up under the test of time.

3. Electrotherapy in the past has been discredited by many of us for the reason that it has been in the hands of charlatans and quacks who have exploited it for commercial reasons only.

Diathermy, as a therapeutic measure in urology has been under my investigation for the past seven years. However, I desire to make clear at the outset that it was not employed to the exclusion of the other standard therapeutic measures, but as an adjuvant to them.

In the following paragraphs I shall attempt to give you briefly the high points regarding the value of this physical agent and its technic of application. I shall omit any reference to the principles upon which high frequency currents are produced, as I feel confident that all are conversant with its fundamentals and its effects on tissues.

In the male the following gonorrheal infections were treated: acute urethritis, early acute epididymitis, acute prostatitis, subacute and chronic prostatitis and vesiculitis.

In the female, acute gonorrheal urethritis, acute, subacute and chronic gonorrheal endocervicitis were treated.

Surgically, diathermy was employed principally in the management of bladder tumors and urethral caruncles.

### APPLICATION IN THE MALE (TECHNIC).

*Acute Urethritis:* Two distinct ways of applying diathermy to the urethra are recognized, the intra-urethral and the clamp method. I will describe the latter, as the first method was not tried. The clamp consists of two metal electrodes so constructed that they can be applied to the lateral walls of the penis like a splint. A thermometer is inserted into the urethra and a temperature of  $42^{\circ}$  C. to  $45^{\circ}$  C. is obtained. Length of treatment is from thirty to forty minutes, and the number of treatments are variable.

*Results:* The application of diathermy to the urethra did not in any way influence the course of the disease favorably or unfavorably and although this method was applied in the early stages of disease, it did not seem to hasten the termination of infection any more quickly than the usual standard methods of therapy.

### APPLICATION IN ACUTE EPIDIDYMITIS (TECHNIC).

Diathermy is applied here by means of a slightly modified Corbus clamp. The current is started and gradually increased up to the point of the patient's tolerance. It is then reduced until there is evidence of a comfortable sensation in the scrotum. The duration of the treatment is approximately forty-five minutes to one hour, the number of treatments are variable, the average being four.

*Results:* In acute epididymitis, particularly in the early stages of the disease, it has been unusually effective. The pain and tenderness are invariably relieved after

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the first application and swelling of the epididymis shows appreciable diminution after the third or fourth treatment.

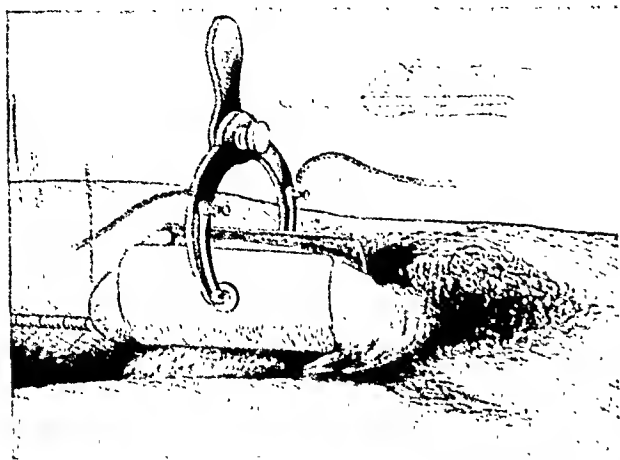


FIG. 1. Method of applying clamp electrode to lateral walls of penis.

Only in a few instances has it been necessary to confine these patients to their

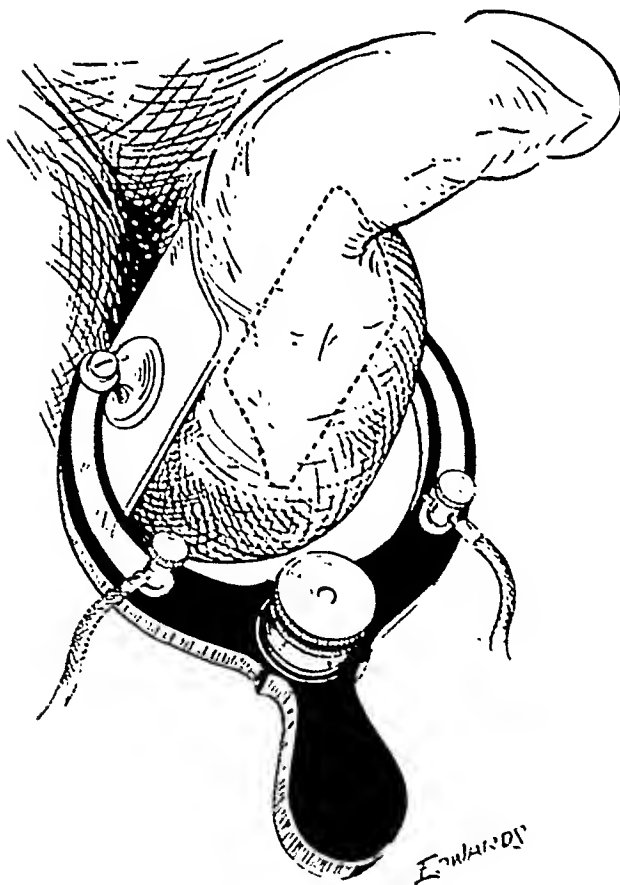


FIG. 2. Method of applying slightly modified Corbus electrode to epididymis.

homes or hospital. I am convinced that diathermy is one of the most efficient agents we have in combating the pain of an

acute early epididymitis. However, when there is evidence of an abscess formation within the epididymis as manifested by

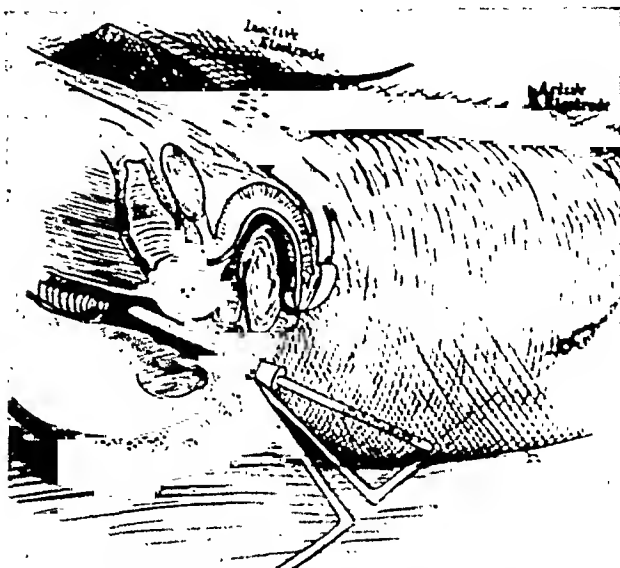


FIG. 3. Method of applying diathermy to prostate with Cumberbatch prostatic electrode.

intense pain, high temperature, chills and an increased leucocytosis, diathermy is contraindicated and the classical operation of epididymotomy must be performed for the relief of the condition.

#### APPLICATION TO PROSTATE AND VESICLE (TECHNIC).

(Acute, Subacute, Chronic Prostatitis, and Vesiculitis.)

A prostatic thermophore is employed, one designed by Elkin P. Cumberbatch of the University of Cambridge, London, England.

The patient is placed in a dorsal position and the dispersing electrode is placed over the suprapubic region. The prostatitis electrode is properly lubricated and is introduced into the rectum for a distance of 3 in. The current is started and slowly increased up to the patient's tolerance, then slightly reduced. The duration of the initial treatment is about thirty minutes and gradually increased for subsequent treatment until one hour is reached. The number of treatments varies with the duration of the disease, the average being from six to eight. They are given at intervals of approximately five days.



*Results:* I have found diathermy to be of great value in the treatment of acute prostatitis and seminal vesiculitis. Relief

2. It reduces the length of time required for clinical cure, and decreases the number of recurrences.

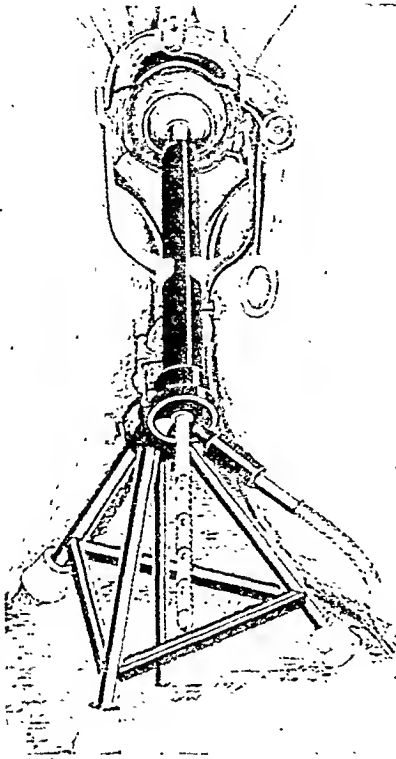


FIG. 4.

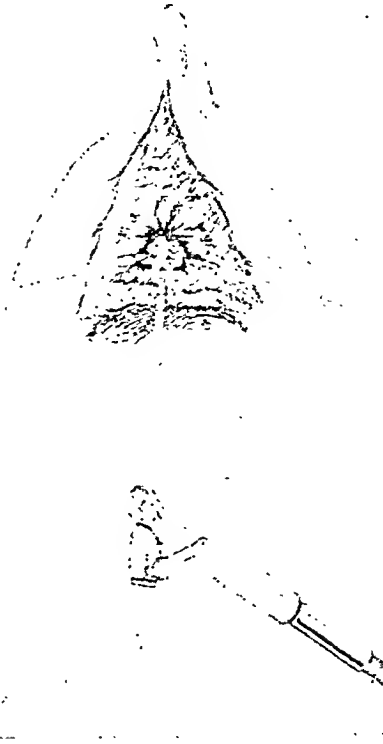


FIG. 5.

FIG. 4. Method of applying cervical diathermy with Corbus thermophore, which has Tarbell disc attached to it.

FIG. 5. Method of destroying urethra caruncle by means of a Timberlake endoscopic electrode.

of pain, diminution in size of the gland and general systemic improvement have been noted in the patients following the application of prostatic diathermy.

In subacute and chronic prostatitis, I consider the application of medical diathermy the therapeutic agent of choice. It is beyond all doubt the most effective means at our command for the purpose of promoting and stimulating drainage from infected non-draining prostates and seminal vesicles. My experience with it conclusively demonstrates the following facts:

1. It renders certain prostates that are exceedingly sensitive to prostatic massage less so when the massage has been preceded by diathermic application.

3. It reduces in a great measure the need for vigorous provocative treatment.

#### APPLICATION IN THE FEMALE URETHRA (TECHNIC).

The patient lies on her back, the dispersing electrode is placed over the suprapubic region and a Corbus thermophore is inserted within the lumen of the urethra. It is maintained in position by means of a tripod stand so constructed that the electrode can be adjusted to any position desired. Current is started and increased gradually until a slight sensation of discomfort is noted. Strength of current is then reduced until the discomfort disappears. The temperature obtained is between 108°F. and 110°F., duration

of treatment thirty minutes, and usually one to four are necessary.

*Results:* In the majority of cases diathermy has lessened the severity of the acute symptoms, caused a more rapid destruction of the gonococcus and reduced the number of paraurethral complications.

#### APPLICATION IN ACUTE AND SUBACUTE ENDOCERVICITIS (TECHNIC).

Dispersing electrode consists of a double plate, one placed over the suprapubic region and the other below the sacrum. A slightly modified Corbus cervical thermophore is inserted into the canal of the cervix, and supported in position by the tripod stand described in the previous paragraph. The current is started in the usual way and increased to the point where a temperature of  $45^{\circ}\text{C}$ . is reached, and maintained for a period of forty-five minutes. The number of treatments varies; usually three to six are required.

#### APPLICATION IN CHRONIC ENDOCERVICITIS (TECHNIC).

The technic in the treatment of this condition utilizes both medical and surgical diathermy. The cervix is exposed with a vaginal bivalve speculum, cotton applicators saturated with an alkaline antiseptic are applied to the endocervix which is then sponged thoroughly dry by narrow strips of gauze. A Corbus thermophore is inserted into the canal and a diathermy treatment of about twenty minutes duration is given. This latter step is for the purpose of obtaining cervical dilation as a preliminary to the application of electrocoagulation.

A specially designed cervical electrode is then inserted into the endocervix, the current is turned on and gradually increased until the entire surface is properly coagulated. It is often necessary to give from one to three treatments to obtain successful results.

*Results:* It accelerates the disappearance of the gonococci from the endocervix, causes the discharge to lose its purulent characteristics and reduces its amount,

permits more efficient topical application of antiseptics to the cervical canal and lessens the tendency for the infection to

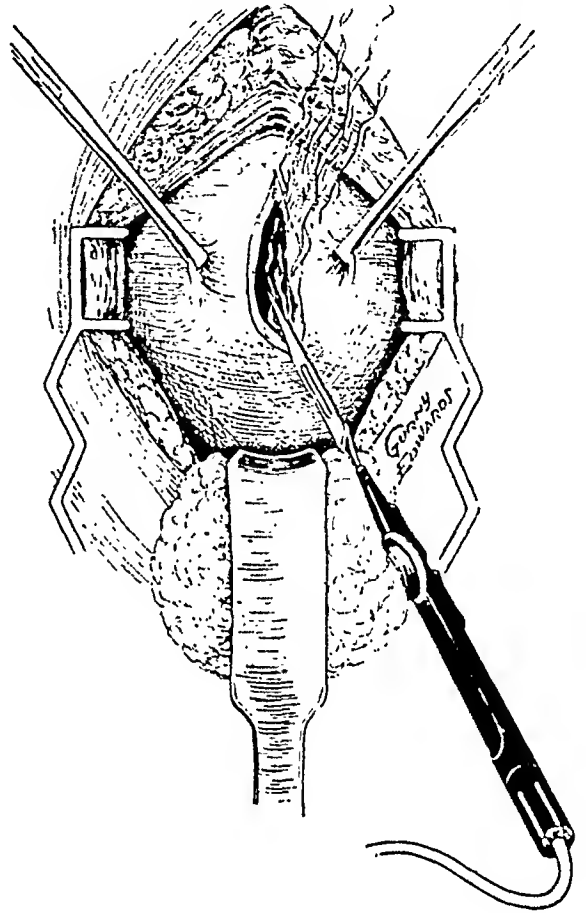


FIG. 6. Method of incising bladder wall with Groff diathermic knife.

become chronic. In the presence of complications of the adnexa or in the severe acute stages, diathermy treatment is always contraindicated.

I consider diathermy, when it is properly employed, one of the most satisfactory agents at our disposal for the treatment of the above infections.

#### SURGICAL DIATHERMY

##### URETHRAL CARUNCLE (TECHNIC).

The dispersing electrode is placed over the suprapubic region. A mild D'arsonval current is used and electrocoagulation is performed by inserting the point of a Turner or Timberlake endoscopic electrode into the base of the growth in one or several places. As this procedure is continued the entire mass assumes a grayish appearance indicating that sufficient de-

struction of tissue has taken place. It can be repeated at a later interval if necessary.

*Results:* Urethral caruncles respond suc-

Tumors that are pedunculated and situated either on the posterior or lateral walls are most easily removed by utilizing

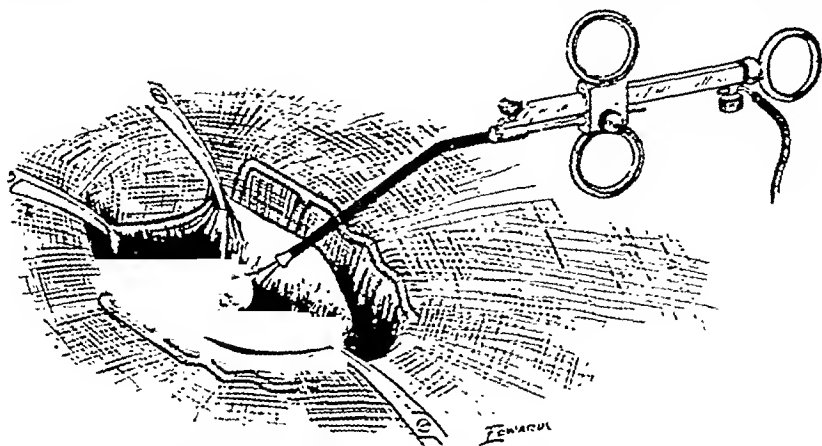


FIG. 7. Method of removing bladder tumors with diathermy snare.

cessfully in the majority of instances to the effects of electrocoagulation. I consider it the logical and ideal method for treating this troublesome and painful growth. The recurrences are less than when they are removed by the knife.

#### TUMORS OF THE BLADDER (TECHNIC).

Two methods of applying high frequency current for the treatment of this condition are recognized: the transcystoscopic and suprapubic transvesical. Since the former method is not unusually difficult and fairly well standardized, I will omit any discussion of it, and describe the technic of the latter. The first step in this procedure is the proper arrangement of the machine settings to determine the proper depth and degree of coagulation which can be produced with the different active electrodes. The dispersing electrode is usually placed below the sacrum. The usual suprapubic median incision is made. The bladder is freely mobilized and opened with a knife that utilizes a true diathermy current or the so-called high frequency cutting current; the bladder is carefully emptied of its distending fluids by means of a suction pump. Self retaining tractors are inserted and careful inspection of the interior of the bladder made. Further subsequent steps in the operation will depend upon what is disclosed at the time of inspection.

the diathermy snare as the active electrode. The snare is adjusted so as to encircle the base of the tumor rather snugly. The current is started and gradually increased while the loop of the snare is closed tightly around the pedicle. In this manner the tissues in contact with the loop of the snare are coagulated and removed simultaneously.

Large infiltrating non-pedunculated malignant growths situated in the vicinity of the base of the bladder wall are removed most effectively by means of the disc or globe-shaped active electrodes. The removal is accomplished by coagulating carefully to a certain depth of the tumor and then removing the necrotic material so produced. This process is repeated until the base is reached which also is gently and mildly coagulated.

Tumors involving the dome of the bladder wall can be removed most satisfactorily by first thoroughly coagulating it with the disc or globe-shaped electrodes followed by a resection of the adjacent bladder wall either by means of a diathermy knife or the endothermic scalpel.

Circumvallation is employed with all of these steps. It consists in isolating the tumor from the rest of the bladder wall by creating an impermeable barrier of coagulated tissue.

Proper regulation of the current strength

plays an important part in determining the success of all these procedures. It is exceedingly essential that the current should be mild at first and slowly increased to obtain its deep effects; only in this manner can we avoid the development of carbonization, a condition that insulates the tissues by producing a char, which in turn prevents the proper penetration of the heat into the deeper portions of the growth.

**Results:** The advantages of diathermy in the management of bladder tumors are many. The following are the most important:

1. The treatment can be made bloodless because of the thrombosis which occurs in the underlying blood vessels in the field of operation.

2. The danger of metastasis and recurrences is minimized because of the destruction of the tissue cells below the level of those which have been removed, and also due to the thrombosis that occurs in the lumen of the blood and lymph vessels in the area treated.

3. Bladder deformity with its associated decrease in size is obviated to a considerable extent, because the tumor is destroyed in situ and segmental resection of the contiguous bladder wall is seldom necessary.

4. It is my belief that this physical agent has a greater field of application in the treatment of tumors of the bladder

than any other procedure. While still not the ideal method, it is by far the most efficient one known at the present time and

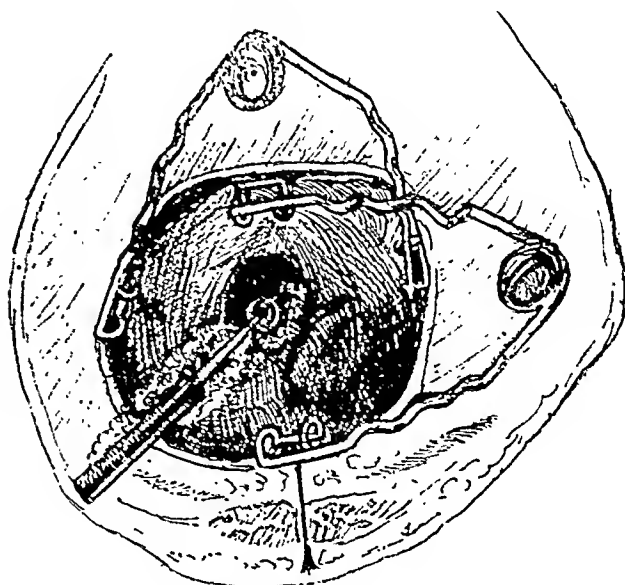


FIG. 8. Method of coagulating tumors of bladder by disc-shaped active electrodes.

offers the patient a better chance of obtaining permanent or temporary relief.

#### CONCLUSION

The practical application of diathermy as a therapeutic aid in the management of diseases of the genitourinary tract is dependent upon many essential factors: the establishment of a correct diagnosis, the possession of the proper high frequency machine with suitable electrodes, and an exact understanding of the basic principles of high frequency currents.

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# INTERPRETATION OF DOUBLE URETERS\*

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MORE advance has been made in urology in the past decade than in any other specialty. The recognition of pathology of the kidney and ureter has been greatly aided by the cystoscope and roentgenological procedures that are now available. Not only as a diagnostic measure but as a means of therapy and relief of pain has this resource been utilized. Vague abdominal and pelvic pains are no longer considered as causes for exploratory surgery but as definite surgical problems usually confirmed either by the pyclogram, ureterogram or cystogram. It appears that still further advances are to be made in this specialty, more within the reach of general practitioners, as evidenced by recent reports of Lichtenberg of Berlin and Swick of this country.

In considering congenital abnormalities of the kidney and ureter one is amazed at the unusual and grotesque malformations that may be encountered. With advance in urological study this has been more frequently brought to our attention. Yet when we carefully study the embryology of this system we can readily see how easily such malformations may take place, and in turn wonder that the percentage of error is not even greater.

The earliest form of an excretory organ is the pronephros. This consists of a series of tubules enclosing a network of capillaries, arising from segments which later form the cervical region. Between the third and fourth week of embryonic life their development is completed. This structure never functions but is of embryological interest only because of the persistence of the duct which plays a rôle in the further development of the kidney and ureter. In addition to the pronephros is a second structure which like the former never attains maturity. This is the

mesonephros which arises from a second series of tubules located more caudally. These tubules broaden at their proximal end, and are enclosed by a capillary network, the glomerular. The distal ends empty into a common duct, the Wolffian duct, which in earlier life is called the primitive ureter. At about the third month of embryonic life, the secretory portion with its glomerulus disappears although a certain portion of the tubules persist. In the final state of fetal development, portions of the duct remain as the vas deferens in the male, and as the rudimentary Gartner's duct in the female. At a time when the pronephros has entirely disappeared and the mesonephros is degenerating, the third and permanent formation of urinary tubules begins to appear. This is the metanephros and the embryo has now reached a length of 5 mm. The origin is from a group of cells situated caudally and called the nephrogenic tissue. This eventually develops into the secretory portion of the urinary apparatus. At about the fifth week there is seen the first evidence of the excretory portion which arises in the form of a hollow bud from the Wolffian duct. This bud grows cephaladly, entering the renal blastoderma, and from it will be formed eventually the calyces, major and minor; collecting tubules, renal pelvis and its ureter. As the ureteral bud grows cranially it develops a cranial and caudal limb, which represents the major calices. Two other buds soon grow out from the renal pelvis, one dorsally and the other ventrally. These 4 limbs or buds represent the major calices each of which in turn divide into 2 to 4 collecting tubules, which represent the minor calices. A course of constant branching now occurs so that by the fifth month of fetal life, tubules of the third and up to the thir-

\* From the Urological Department of Flower Hospital. Submitted for publication March 25, 1930.

teenth order have been formed. Cells of the nephrogenic tissue surround these tubules, which in turn develop a lumen and

the kidney develops much less than the trunk, so that we find the upper border remaining at the eleventh rib, while the



FIG. 1. Complete duplication of right pelvis and ureter. Apparent crossing in lower third of ureter.

a capillary network, the glomerulus. The latter grows into the proximal end of the tubules.

The kidney tissue proper arises from the nephrogenic tissue which as the renal pelvis develops, surrounds it in fan-like fashion giving it the lobular arrangement. It is of interest to note further the change in position of the kidney occurring during development. As the ureteral bud grows cranially the metanephros moves from the pelvis into the abdomen coming in contact with the adrenal. At the second month the kidney lies at a level corresponding to about that of the first to the fourth lumbar vertebra. At about the fifth month the upper pole is at a level with the eleventh rib and the lower pole at the fourth lumbar vertebra. As development now progresses,



FIG. 2. Three small calcium deposits in left pelvis (extra-ureteral).

lower border moves up to the second lumbar vertebra.

The most common anomaly encountered is that of ureteral reduplication. Many explanations have been made as to why in one case we have a partial reduplication of the ureter and in another a complete reduplication. As yet no explanation has completely covered the issue and it may only be said that such abnormalities of the ureter are the result of some failure of the renal bud to develop properly, this failure being usually in the form of some premature or exaggerated bifurcation of the hollow bud in its caudad development from the Wolffian duct. In reviewing the embryology of this organ it may be readily seen how easily the histological progress may be altered. A second ureter may arise due to an accessory bud of the Wolffian duct. This may grow cranially in steady progress as its companion, and in similar fashion enter the nephrogenic tissue and divide, forming pelvis and calices quite distinct and separate from those of the other ureter of the same side. If such be the maldevelopment we will find 2 ureters (on the same side) with 2 distinct ureteral orifices in the bladder on the same side,

being separate through their course to the kidney and their becoming distinct. Secondly it may be assumed that instead of



FIG. 3. Double right ureter. Same case as Fig. 2, found in routine examination.

an additional budding at the Wolffian duct only 1 bud develops. In its development this bud which eventually forms the ureter may divide before it enters the metanephros. This bifurcation may occur at any level between the origin at the Wolffian duct and its termination at the kidney itself. Clinically such cases are spoken of as complete and incomplete reduplication. By complete reduplication we refer to those cases where there are 2 ureteral orifices on the corresponding side of the bladder, 2 ureters and 2 renal pelves. By incomplete reduplication we refer to those cases where there is a single ureteral orifice, but the ureter divides at some level, forming into 2 ureters and entering into 2 renal pelves.

The double ureter is often not associated with any notable pathology of the kidney and often escapes complete attention. One case that came to our attention was very striking in this respect. This individual

complained of severe backache, but of no other complaint. In confirming the diagnosis of a sacroiliac subluxation a plain plate was taken. This plate revealed a normal lumbosacral articulation, with interarticular space of the right sacroiliac joint greater than that of the left, and the pelvis as symmetrical. Small calcium deposits were seen in the left pelvis. Number one of these shadows is near the lower end of the left ureter, number two and three appeared as if they might be either in the bladder, seminal vesicles, prostate or pelvic veins. It was decided that further information could only be obtained by the use of the opaque catheter. Subsequent cystoscopic study and pyelography revealed these calcium deposits not to be in either of these localities, and in completing the routine examination a study of the opposite side was made. Two ureteral orifices were found on the right side and upon catheterization, the 2 opaque catheters were visible on the right side extending up to the right kidney with 2 distinct pelves. The upper pelvis was small and the lower pelvis normal in size. Catheter specimens were normal, and all culture specimens were sterile after two days' inoculation. Intravenous injection of indigo carmine showed a normal function both of the right and left kidney. The dye appeared from the right catheters in eight minutes and from the left in five minutes with maximum concentration in dye from both sides in nine minutes. This man's pain and discomfort were quickly relieved by application of a sacroiliac belt. He has been under observation for the past year with reference to the bilateral ureters on the right side which at no time gives him any discomfort. Sterile specimens collected from this side at all times have failed to show any bacterial invasion or interference with the function of this kidney. This man reports periodically for examination, for it cannot be overlooked that the interference of urine with its free passage from the renal tubules predisposes to renal infection. With the presence of bilateral ureters and particu-



larly where one ureter may cross the other, it may be readily seen how obstruction to the free passage of urine may occur.

the same kidney appears purulent. Such was the experience encountered last winter by our service in the following case.



FIG. 4. Small contracted pelvis with distinct major and minor calices. Urine specimens clear and good quantity. Dye (indigo carmine) appearance in five minutes with maximum concentration in six minutes.

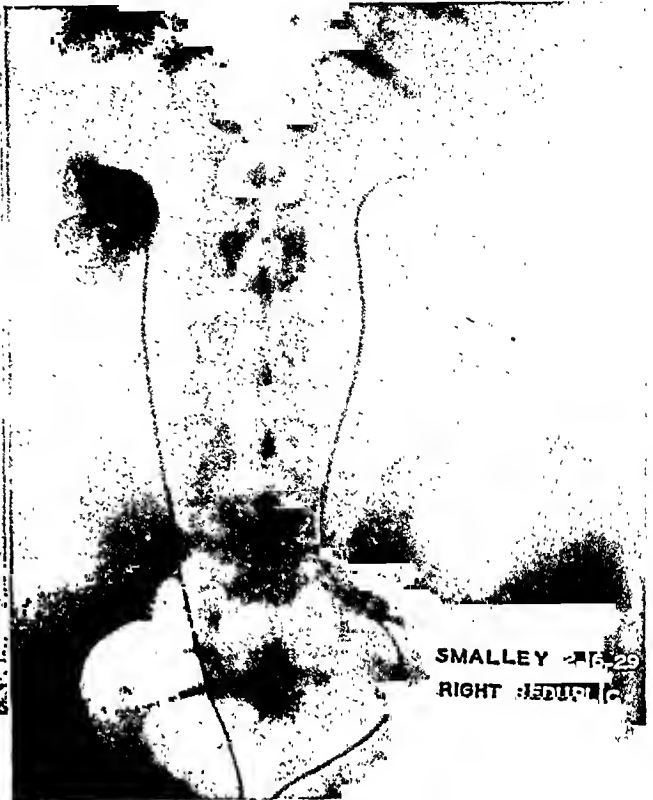


FIG. 5. Same case as in Fig. 4, illustrating markedly dilated lower pelvis. Thickish greyish pus obtained only on aspiration. No appearance of dye within twenty minutes.

That there may be failure of renal bud development to occur on both sides is evidenced by reports of cases with bilateral double ureters. We have had no such cases on our urological service but Figure 8 demonstrates this condition which is a case taken from the private practice of Dr. Louis Rene Kaufman.

Supernumerary ureters are of great importance, not only by their presence or absence but because of the relation they bear in diagnosis of vague and often confusing urological findings. Ignorance of their presence may prove to be very misleading. It may readily be seen that the kidney with a double ureter may be partially bifurcated, and on catheterization (ureteral) the urine appears normal, whereas in subsequent examination perhaps by another observer, the urine from

Patient was admitted to the hospital complaining of pain in the right lower quadrant. Pain had been present for eight days. No previous attacks. No dysuria, hematuria or pyuria. Physical examination was negative with the exception of a positive Murphy sign on the right side. In view of the history of pain in the right hypochondrium and right lumbar region of eight days' duration, with presence of slight dysuria, it was suggestive of (1) calculus or (2) hydronephrosis. Cystoscopy was advised and study to be made with constant observation for possible acute appendicitis or other acute intraperitoneal lesion. Cystoscopic examination revealed the bladder to be normal in appearance with the exception of a slight ulcerative area seen above the right ureteral orifice. The left ureteral orifice was easily visualized and normal in appearance. Number five catheters were passed without difficulty both on the right and left side. Urine specimens appeared clear and in good quantity. Indigo

carmine injected intravenously appeared in four minutes on the left side and five minutes on the right side with maximum concentration

upward in almost a straight line, suggesting the so-called rigid pathological ureter. In carefully considering the findings as presented

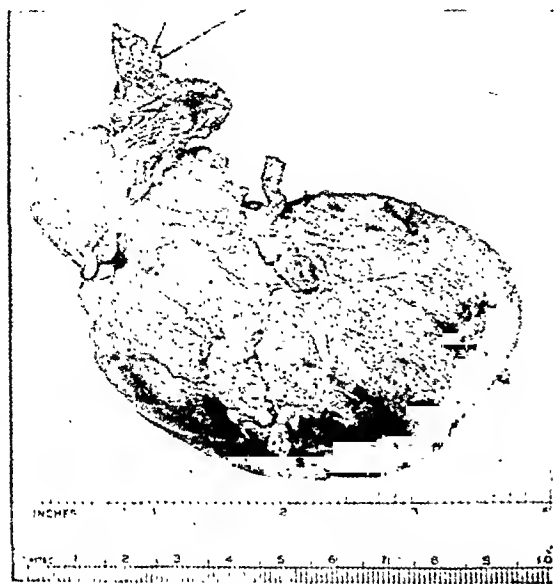


FIG. 6. Double renal pelvis. Same case as Fig. 4.



FIG. 7. Kidney opened.

and equal on both sides in six minutes. Pyelograms taken appear as shown in illustrations. The pyelogram of the right kidney showed a small contracted pelvis. No definite irregularities or other pathology observed. The left kidney appeared normal in size, shape and position. Subsequent cystoscopy performed one week later shows the mucosa normal, except the trigone. No stone, tumor or diverticulum observed. Capacity normal. Marked redness limited to the right half of the trigone. Moderate edema of the right aperture which is dilated and elongated. One centimeter behind the right aperture is an irregular area of superficial ulceration about 5 mm. in diameter. A droplet of thickish greyish pus is expelled with a cloudy efflux from the right aperture. The left aperture is with normal peripheral mucosa and clear efflux. Number five catheters are passed without difficulty. Drainage from the right side promoted by aspiration is cloudy and purulent and with appreciation of about 25 c.c. The left side is clear. Indigo carmine injected intravenously appears on the left side in five minutes and with maximum concentration in six minutes. No dye appears on the right side in twenty minutes. Pyelogram of right kidney showed a dilated pelvis and calices. The end of the catheter was coiled in on itself in the upper part of the pelvis. The right ureter is rigid in appearance, extending

one might interpret them as 2 distinct cases. The findings as enumerated are by two different men at separate sittings. Thus it may readily be seen that the presence of bilateral ureters if unrecognized may lead to much confusion in diagnosis. This particularly so when on one catheterization the urine of one kidney appears clear, and upon subsequent examination, the urine from the same kidney appears purulent. Keyes states and rightly so, that such condition has led to a false diagnosis of the spontaneous cure of renal tuberculosis. Such a mistake can easily be made by even the most capable of men.

Nephrectomy was performed on this patient; the specimen being described as consisting of a kidney and 2 ureters, measuring 12 cm. in length, 5 cm. in width in the upper pole and 4 cm. in width in the lower pole. Externally the organ was divided into 2 portions, the upper pole, covering two-thirds of its surface, resembled normal kidney, in its contour, color and consistency. A thin ureter normal in consistency appears at about the center of this division of the organ. The lower pole has a whiter hue, covers the lower third, and is soft in some areas and firm in others. From the upper portion of this region a thick wide ureter appears. Its external surface shows a definite congestion. On section the upper pole is seen to consist of normal kidney parenchyma, the

pelvis being clear and smooth. The lower pole has an entirely abnormal appearance. There is a small rim of rather pale kidney paren-

to have had malaria and possible infection of the kidney. This bit of information was rather vague and unreliable. Cystoscopic examination

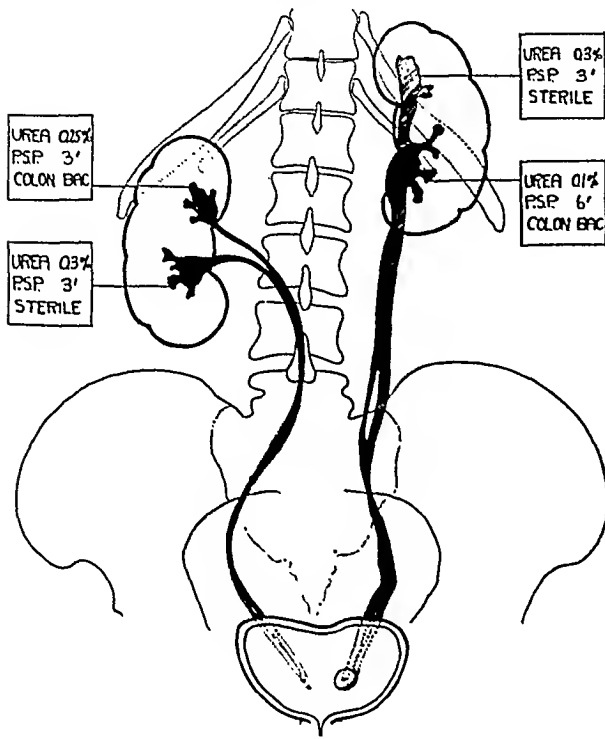


FIG. 8. Bilateral ureters showing function of various portions of kidneys as obtained from catheterized urine specimens.

chyma. The remaining area is occupied by a thickened and dilated pelvis which shows the same inflammatory congestion as the ureter with which it merges. The pelvis and ureters are independent. The microscopic pathology was described as that of a chronic suppurative and productive pyelitis of accessory pelvis.

That there may be failure of renal bud development to occur on both sides is evidenced by the report of the following case.

This patient, female, aged forty-five, complained of severe labor-like pains in back and abdomen followed by chills and fever. There was marked frequency and polyuria. First attack lasted two weeks. One month later she had similar attack which lasted ten days and was accompanied by chills and fever. Attacks have occurred at varying intervals of one week to three months with temperature as high as 105°F. The past six months she has complained of severe soreness and dull pain in the right loin which has gradually moved to the left. Past history was essentially negative with exception that as an infant was thought

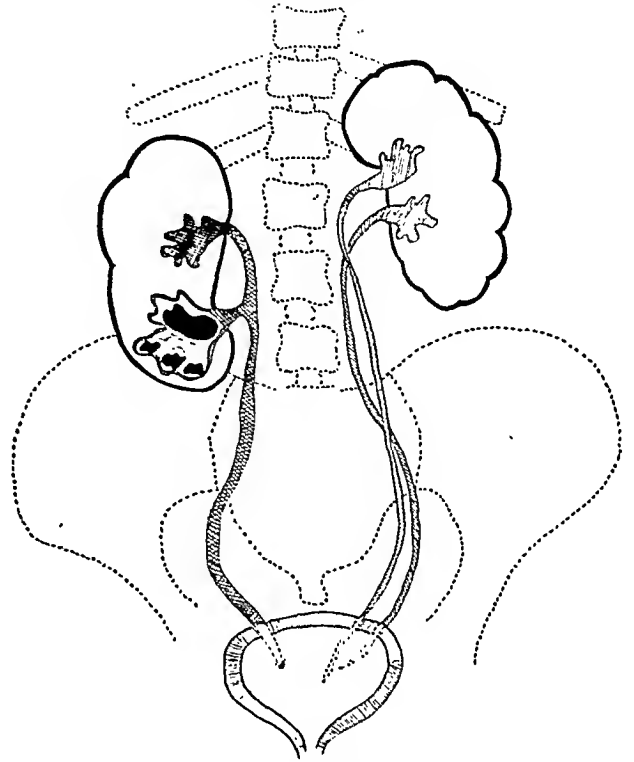


FIG. 9. Right incomplete reduplication with 4 renal stones. Large stone in lower calyx and 3 smaller stones in pus pockets of lower pole. Left complete reduplication.

revealed bladder with capacity of about 350 c.c. There was a slight loss of luster in the vessels over the dome, with normal side walls. Trigone superficially reddened with injected vessels. An area about 1 cm. in size anterior and to the right of the right ureteral aperture showed edema. Mucous membrane in folds suggesting a disappearing bulbous edema. The right half of the trigone shows 2 ureteral apertures which are equal and prominent lying on a pale ureteral ridge with normal spurts. Left half of the trigone shows a similar ureteral ridge ending in a smooth, tense swelling which gradually becomes more swollen and more tense, showing sudden discharge of clear urine through a small pinpoint aperture. The swelling disappears immediately following the discharge of the urine. Above and to the left of this is a ureteral aperture of about the size of the right aperture which becomes obscured and again evident with the filling and emptying of the ureterocele. The ureterocele measured about 1 cm. in breadth. X-ray catheters were passed readily up all the ureteral orifices on the right and left side. Films were made of the kidney tract after the injection of sodium iodide into the pelvis

and calices of both kidneys. The kidneys were otherwise normal in size, shape and position. There was no evidence of any destructive

been made to show the function of the various portions of the kidneys as obtained from catheterized urine specimens.

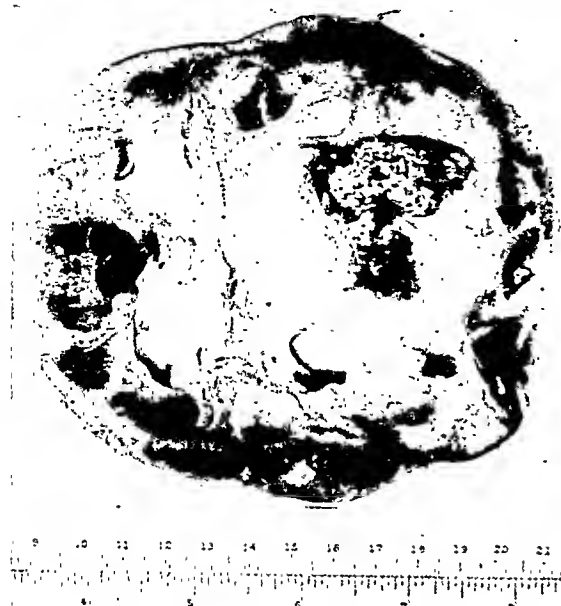


FIG. 10. Double pelvis. Pyonephrosis open. Stones in situ.

process involving any of the calices. The upper pelvis and calices in both kidneys were smaller than the lower ones, but there was no evidence of any organic pathology. The right kidney was lower than the left kidney, the lower pelvis being opposite the transverse process of the



FIG. 11. Renal stones. Same case as Fig. 9. Large branching stone in lower calyx. Three smaller stones in pus pockets in lower pole. Diagnosed extrarenal. (Courtesy Dr. L. R. Kaufman.)

third lumbar vertebra, while the lower pelvis of the left kidney was opposite the intervertebral discs between the first and second lumbar vertebrae. The course of the ureters was normal. There was no evidence of any calculi. Figure 8 is a reproduction of findings as described before. In this diagram an attempt has

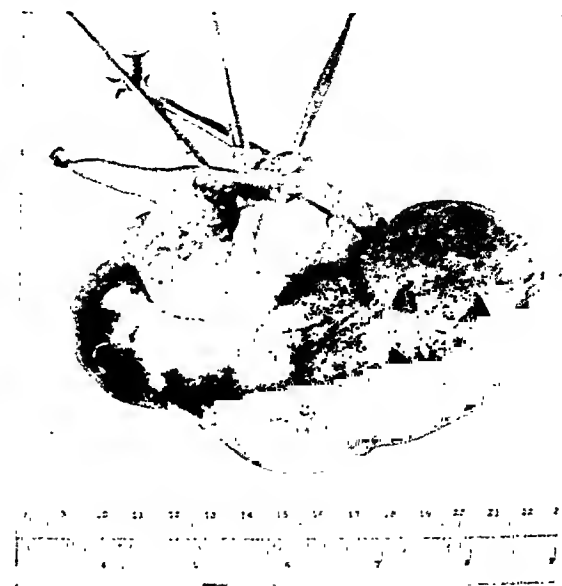


FIG. 12. Same case as Fig. 9. Double renal pelvis. (Courtesy Dr. L. R. Kaufman.)

The following case is reported because of its unusual interest in its relation to the presence of double ureters. This case taken from the private practise of Dr. Louis Rene Kaufman is of singular interest in that in addition to the presence of an incomplete reduplication of the ureter on one side, there was also present extensive productive inflammatory changes.

This patient was a widow, aged forty-five, complaining of general nervous symptoms as fatigue, exhaustion and nervousness. Her abdominal pain was vague both in character and in location but presumably in the right lower quadrant. Urination had been accompanied by feeling of obstruction, with very little increase of frequency, amounting to four or five times by day and none by night. Abdominal examination revealed a firm median scar, good musculature, no marked tenderness. The lower pole of the left kidney could be palpated on deep breathing. The right kidney could be felt to be about three times the normal size, extending from a point 3 fingers' breadth below the costal margin with the lower pole well below the iliac crest. The kidney could be replaced within the renal fossa but would not remain in place. The

contour was smooth and except for gross enlargement was about normal. Cystoscopic study revealed bladder capacity to be about 300 c.c. The bladder as a whole presents a slight loss of luster with here and there enlarged and increased blood vessels. There was definite granular redness of the trigone but without marked organic pathology. The right ureteral aperture was somewhat prominent, reddened and contracted; the left ureteral aperture was approximately normal, although somewhat contracted and small. Just to the left of the left aperture directly in the mucous membrane without the usual implantation of the ureter was seen a slit-like opening somewhat smaller than the left aperture but with a vigorous spurt. At the first cystoscopic examination an x-ray catheter was passed on the right and left side readily and penetrated the apertures to the renal pelvis. Phenolsulphonaphthalein test and specimens collected plus the evidence of the pyelogram demonstrated that at this examination that the collection was only from the right kidney and from the upper renal pelvis of the left kidney. At a subsequent examination the right kidney was disregarded and specimens were collected from the 2 pelves of the left kidney. At this examination a number five catheter was readily passed in the main ureteral aperture and a number four in the farthest left of the 2 left apertures.

Mayo incision made by Dr. Louis Rene Kaufman, delivered this kidney with difficulty but demonstrated readily the double renal pelvis with single ureteral implantation. A calculus was found in the lower pelvis with multiple calculi in the lower pole which contained cystic lobule. The kidney was lobulated, the upper pole being smooth and of normal consistency; the lobules increasing from above downward and obviously being filled with fluid at the lower pole. Nephrectomy was performed and patient made a stormy

but successful recovery. Figure 12 demonstrates findings as outlined.

The object of this paper is not to reiterate but to report what we believe to be interesting cases. We believe that in reporting them, it will stimulate the interest of the cystoscopist to look for abnormalities. Such cases may be readily missed if careful study is not given them and if indigo carmine and pyelography are not used.

#### CONCLUSIONS

1. With the advent of modern diagnostic measures more renal and ureteral anomalies are reported than previously. Such anomalies represent embryological errors.
2. These anomalies are more prone to develop surgical complications as a result of obstruction to normal outflow of the urine.
3. All cases of double ureter do not necessarily imply kidney infection reported. Only in cases of obstruction and subsequent infection is there delay in kidney function.
4. A double pelvis does not always accompany complete double ureter. Ureters of double pelvis may fuse just prior to entering the bladder, resulting in presence of one ureteral orifice on side of bladder involved. Case reported.
5. Pyelogram showing an abnormally placed single pelvis in relation to remainder of kidney outline should always lead one to suspect a double kidney. Case reported.
6. Clear urine obtained on catheterization subsequent to previous recovery of cloudy or pusy urine should not be interpreted as spontaneous recovery from kidney infection. Case reported. Such cases should be carefully checked with pyelogram and search for accessory opening.

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# EXTERIORIZATION AND UTILIZATION OF THE SAC AND REDUNDANT PERITONEUM IN THE RADICAL TREATMENT OF INGUINAL HERNIA\*

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THE justification for presenting, what we believe to be, a simple and rational technic of hernioplasty is the fact

1. *Skin Incision.* It follows the usual line.

2. *Exposure and Incision of Aponeurosis*

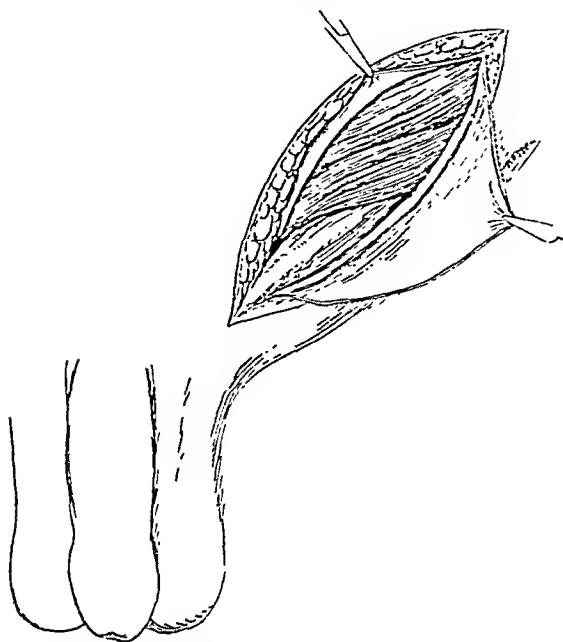


FIG. 1. Fascia of external oblique incised leaving large flap attached to Poupart's ligament which is well exposed.

that recurrences are still numerous after the standard operations. This simplification and rationalization should reduce the number of recurrences.

The aims of the technic to be described are the following: bulgings of the peritoneum as factors in recurrence are completely eliminated; the sac is preserved as an element adding strength to the repaired area; no damage whatsoever is done to the cord; all kinds of inguinal hernias are operated on with the utmost facility, practically without any trauma or hemorrhage, in an amazingly short time, the separation of the cord from the sac being omitted.

The steps of the procedure are the following:

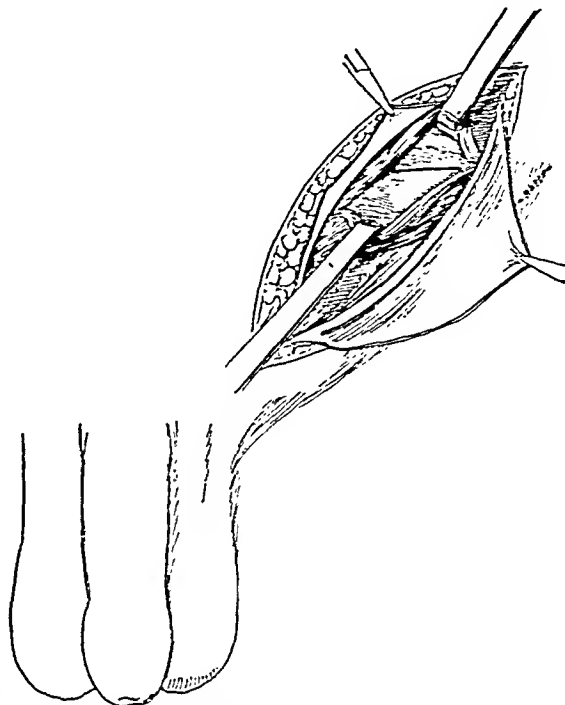


FIG. 2. Separation of fibers of external oblique and transversalis muscles, exposing peritoneum. Black line shows where peritoneum should be incised.

*of External Oblique Muscle.* A flap, as broad as possible, is left on the side of Poupart ligament. The fascia is freed down to Poupart ligament, exposing it clearly (Fig. 1).

3. *Splitting of Fibers of External Oblique and Transversalis Muscle and Exposure of Peritoneum.* The muscular fibers are separated, *not cut or torn*, at a point slightly above the internal ring (Fig. 2) exposing the peritoneum.

4. *Incision of Peritoneum.* The peritoneum is incised parallel to the muscular fibers, the upper and lower edges being seized by 4 clamps (Fig. 3).

5. *Exposure of Internal Ring, Obliteration*

\* Submitted for publication March 26, 1930.

of Any Bulging of the Peritoneum; Exteriorization of Sac and Redundant Peritoneum. This is the most important step. By

unite the inner edge of the fascia to Poupart's ligament, leaving at the lower angle a small opening for the passage of

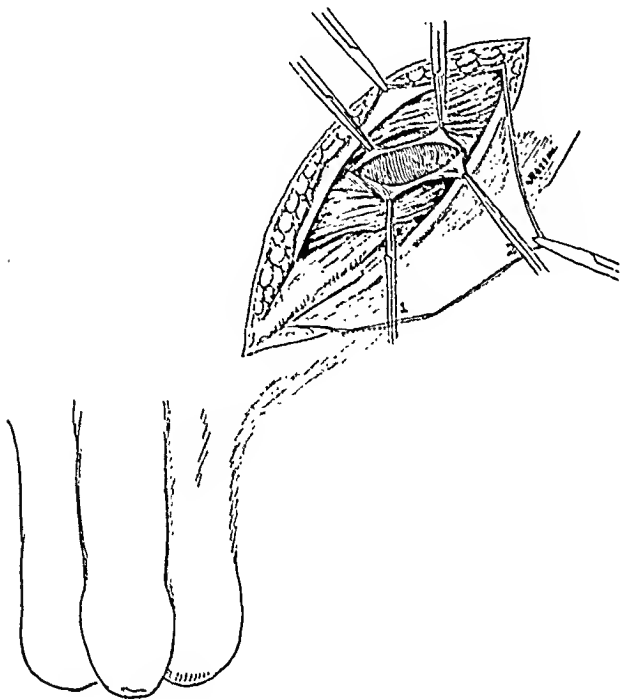


FIG. 3. Peritoneum incised and held by four artery forceps.

pulling on forceps (1 and 2) (Fig. 4) the internal ring is exposed and exteriorized. With thumb forceps the peritoneum below the internal ring is still further exteriorized until a finger introduced in the peritoneal cavity feels that the peritoneum from the pubis to the opening is well stretched. In other words, no bulging peritoneum is left between the points originally corresponding to the internal and external rings. The peritoneum is then closed by suturing the upper edge (B) (Fig. 4c) to the peritoneum below the internal ring, thus exteriorizing the internal ring itself with the sac and all the redundant peritoneum. By this suture the internal ring and all the redundant peritoneum are excluded from the peritoneal cavity. (See Figs. 8-11.)

6. *Fixation of the Sac. Repairing of Split in Muscles and Suturing of Fascia.* The sac and redundant peritoneum are secured with a stitch under the transversalis. Two stitches with plain catgut close the gap in the muscles (Figs. 5 and 6). Mattress stitches with chromic catgut

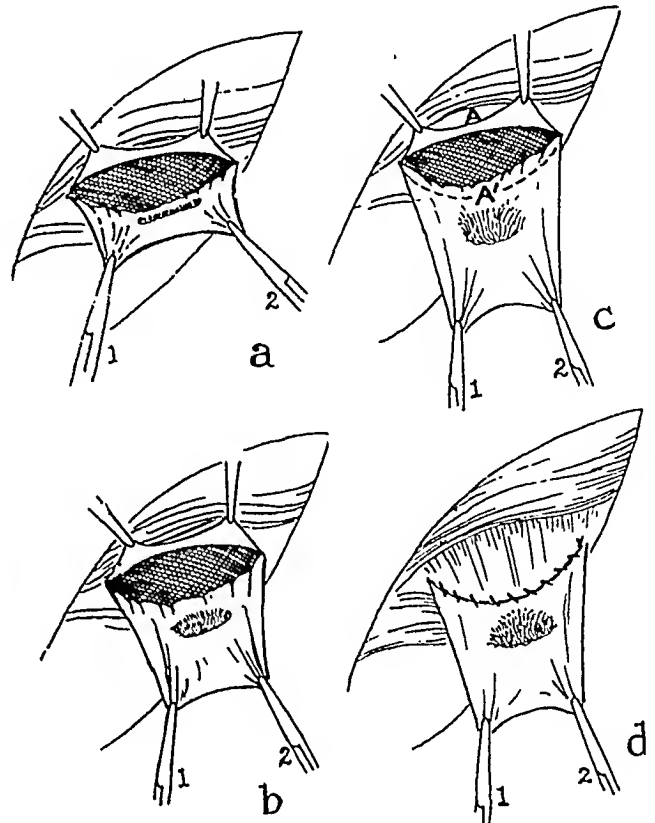


FIG. 4. Internal ring exposed with any redundant peritoneum. How internal ring, sac and redundant peritoneum become exteriorized when peritoneum is sutured. A and B show that by pulling on forceps 1 and 2, internal ring is exposed. Redundant peritoneum is further exposed by means of thumb forceps not shown in illustrations, in order not to complicate them. C shows lines of suture, that is upper edge A is sewed, as shown in D to line A' indicating peritoneum below internal ring, thus excluding from peritoneal cavity internal ring, sac and redundant peritoneum.

the cord. The flap of fascia attached to Poupart's ligament is then overlapped (Fig. 7). The skin is closed thus completing the operation.

#### VARIATIONS IN TECHNIC ACCORDING TO CASES

As any other surgical procedure, hernioplasty has to meet individual cases and indications. Thus, while preserving the main and new principle of exteriorization and utilization of the sac in all cases, the following variations are suggested.

The procedures devised for reinforcing



the inguinal region are so numerous and well known that we shall not even mention them. Many are useful and should be

ized peritoneum under the transversalis without everting the sac (Fig. 10).

#### POINTS TO BE EMPHASIZED

In all cases we use spinal anesthesia; general anesthesia is contraindicated by the fact that some patients may cough after the operation, thus weakening the sutured tissues; local anesthesia is less indicated than spinal, because the infiltration of the tissues by the anesthetizing fluid traumatizes and weakens the tissues, and predisposes to later hemorrhages and recurrences.

The catgut used in all sutures should be moistened before using; dry catgut is too rigid, and the knots, when the catgut is dry, might open. It is advisable to tie a triple knot always, because catgut is very slippery and many recurrences could be traced to stitches that opened.

#### RATIONALE OF THE PROCEDURE

We believe the procedure described here to be simpler and more rational than the standard operations. In fact it is generally agreed that recurrences occur mostly because of failure to remove all of the sac. This might happen because the sac was not ligated high enough, an hour-glass constriction of the sac was mistaken for the real neck, or because double, saddle-bag or pantaloons sacs were overlooked. All these mishaps leave behind a bulging of the peritoneum which favors recurrence of the hernia. If the technic described is followed, leaving behind any bulging of the peritoneum becomes an actual impossibility. Whether the hernia is a direct one, with an oblique sac, or an oblique one, with a direct sac; whether the sac has an hour-glass constriction or not; whether there is any extra bulging of the peritoneum or not; it is absolutely immaterial. All the bulging peritoneum is exteriorized, leaving the peritoneum within the peritoneal cavity smooth and almost as tense as a drum. The main factor favoring hernia, that is, bulging of the peritoneum, is absolutely completely eliminated. The peri-

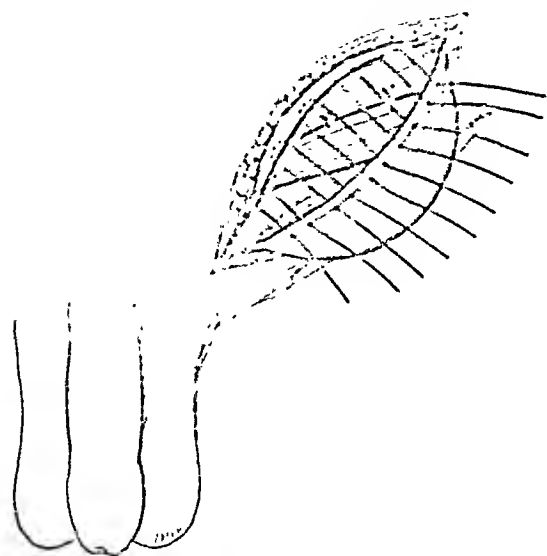


FIG. 5. Gap in muscles closed with two stitches; mattress sutures should approximate inner portion of fascia and conjoint tendon to Poupart's ligament.

utilized in patients with large hernias and weak abdominal walls.

In sliding hernias, the colon is separated from the peritoneum; this separation is rendered easy when the peritoneum is opened as described previously.

Omentum adherent to the sac is freed when possible. When adhesions cannot be freed, the omentum is severed, ligated and dropped into the abdominal cavity. The portion of omentum adherent to the sac and within the sac is not removed, unless it is large. It will form an extra padding to a weak abdominal wall. Strangulated hernias, hernias associated with ectopic testicles, or hydrocele of the cord, are dealt with according to good surgical judgment and technic. In large hernias with enormous sac and pendulous testicle, portion of the sac may be removed and the remaining portion partially or completely everted, and sutured under the transversalis muscle, thus acting as a suspensory ligament for the testicle and reinforcing the abdominal wall (Fig. 11).

In ordinary cases we suture the exterior-

toneal opening is not simply ligated; it is closed with a surgical suture which prevents any puckering at the point of closure.

an element of strength in the repair of the hernia. In fact the thickened peritoneum constituting the sac will form an extra

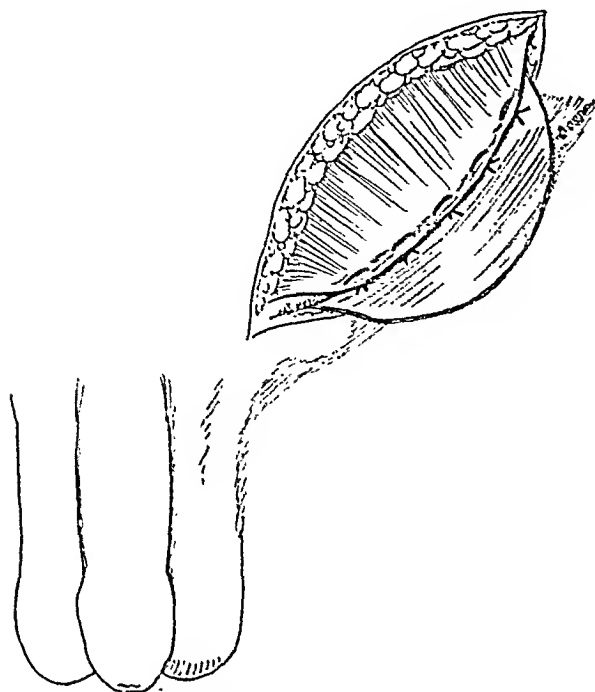


FIG. 6. Mattress sutures tied with flap of fascia ready to be overlapped.

It may be said that recurrence of an oblique inguinal hernia is a physical impossibility, if the sac is exteriorized and any bulging in the peritoneum is abolished, as described here. Figures 8-11 show clearly how impossible it is to leave behind any bulging of the peritoneum, when the sac is exteriorized, according to our technic.

The rationale of operating hernias through an opening in the abdomen was recognized and advocated many years ago by Annandale,<sup>1</sup> Tate,<sup>2</sup> and more recently by Jaboulay,<sup>3</sup> Leriche,<sup>4</sup> LaRoque<sup>5</sup> and the writer,<sup>6</sup> and we shall not insist on the advantages of this technic in all cases of hernias, under all circumstances.

#### DISPOSITION OF THE SAC AND THE CORD

The separation of the sac from the cord is a step which only complicates the operation of hernioplasty. At times it is very difficult: it may cause the formation of an hematoma; it may be followed by atrophy of the testicle, etc. If the sac and cord are not separated, the sac becomes

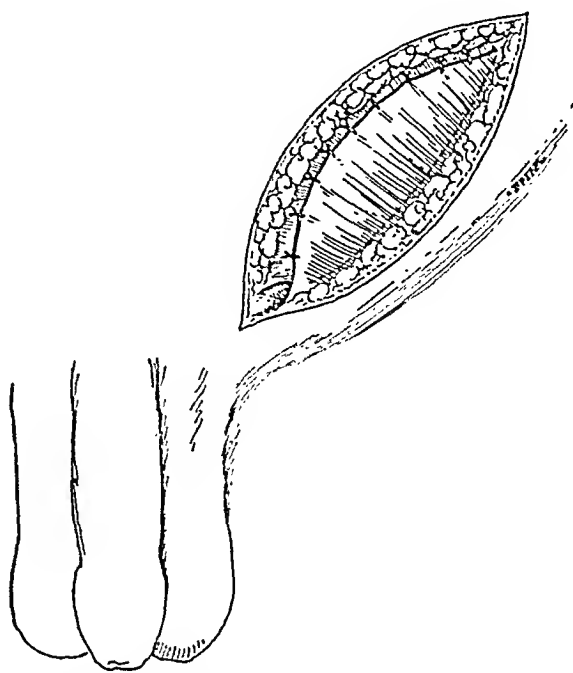


FIG. 7. Dotted line indicates mattress sutures shown in illustrations 5 and 6, covered by overlapped fascia. Note how narrow but secure, a passageway is left for cord at lower angle.

padding of healthy tissue, where healthy tissues are rather scarce. The sac however, when large, may be partially severed and everted and sutured under the transver-

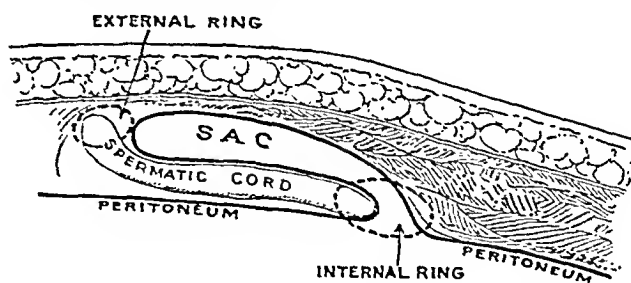


FIG. 8. (Figs. 8, 9, 10, 11 are cross sections of abdominal wall along the inguinal canal. Note that point A of Fig. 4 corresponds to point B of Figs. 8, 9, 10 and 11.) Relations of different structures composing inguinal regions.

salis; thus it will not only serve as a reinforcing pad, but will also hold up the cord and the testicle. The rationale of not transplanting the cord, in fact of not distributing it at all, might seem dubious to surgeons accustomed to all kinds of artifices intended to create a new and more devious passage-

way for the cord. It seems to us that if we observe natural conditions as they actually are, without preconceived ideas, we should

hernia formation, we may state that it is agreed that direct hernia is due to general weakness of the abdominal wall and not

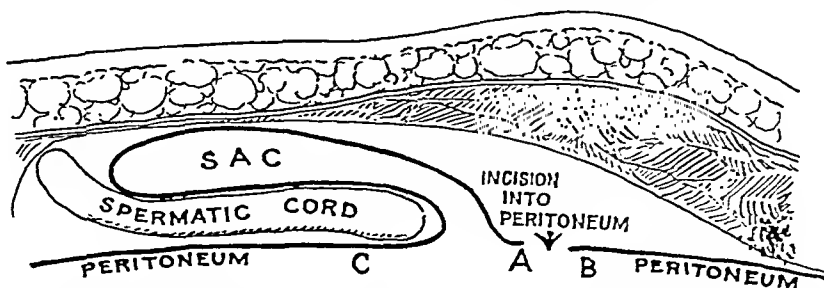


Fig. 9. Peritonum incised, as in frontal view in Fig. 3. Follow points A, B, C of Figs. 10 and 11 to understand clearly how exteriorization of ring, sac and redundant peritonum is obtained.

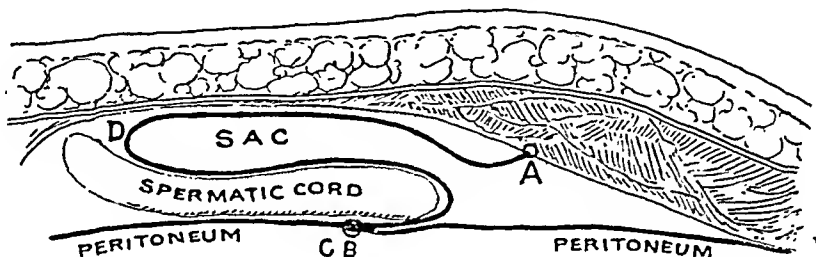


Fig. 10. By suturing peritonum at point B to peritonum at point C, peritonum at point A with external ring, sac and any redundant peritonum are excluded from peritoneal cavity leaving smooth surface. Peritonum at A may be secured with stitch under muscles with or without inversion of sac.

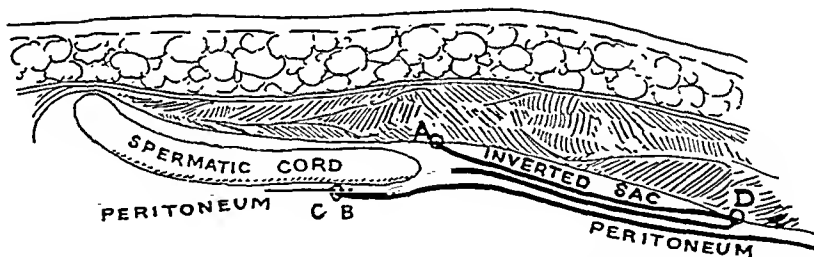


Fig. 11. Sac can be totally inverted and secured under muscles. Obviously inversion may be complete or partial. In illustration, cord remains in same position as in preceding illustrations: actually it follows sac to which it is adherent. Dislodging of cord omitted in order not to complicate illustration.

come to the following conclusions: Direct hernias are very rare when compared with oblique hernias. In practically every adult the external ring is very large; per se it would allow the passage of hernias even of enormous size. That direct hernia occurs very seldom, notwithstanding the large size of the external ring, should make clear to everyone that the external ring per se is not a factor in the production of hernia, either direct or indirect. Without entering deeply into the mechanism of

to the size of the external ring. Consequently, if the cord after hernioplasty comes out at the same spot where it comes out naturally, recurrence should not be, at least, more frequent than when the cord has been transplanted. This is more true when we consider that we repair the tissues above the cord and that the peritoneum below the cord is tense. We must not forget two facts: no matter what we do with the cord its point of exit constitutes a weak point: no matter what we do with

the cord, even if we remove it, direct hernia would recur if the abdominal wall is too weak to stand the strain to which it will be subjected. By the technic recommended here, we have eliminated completely a factor which plays an important part in the production of hernia, that is all kinds of bulging of the peritoneum. No technic will ever eliminate an inherent weakness of the abdominal wall. It should be our aim to make it as strong as possible by surgical means. We believe that by leaving the cord in its natural position, undisturbed, we have preserved blood, lymphatic and nerve supply, which are destroyed when the cord is separated from the sac. This preservation is very important, because a region which is already weak should not be weakened by disturbing the elements which give it strength, that is, blood, lymphatic and nerve supply. By leaving the sac, we have added an extra layer of tissue, which undoubtedly does add strength to the region.

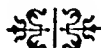
#### CONCLUSIONS

A technic has been described which exteriorizes the sac and any bulging peritoneum; utilizes the sac as a reinforcing tissue to a weak region. By this technic,

atrophy of the testicle, hematomata, injury to the intestine, bladder, vas deferens and spermatic artery are completely prevented. Recurrences of indirect hernia become a physical impossibility. Recurrence of direct hernia is rendered more improbable, because the blood, lymphatic and nerve supply of the region have not been damaged and the region is reinforced by the presence of the exteriorized sac. Trauma and shock, or any other postoperative complications, are reduced to a minimum, little damage being done to the tissues and a very short time being required for the operation. In children and in young adults, the operation has been performed often in less than ten minutes and without even ligating a single blood vessel, when the diathermic scalpel was used. Numerous clinical results, including 2 cases of sliding hernia, 1 strangulated hernia and 1 with ectopic testicle, up to the present time, are very satisfactory.

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\* Continued from p. 139.

# CARCINOMATOUS DEGENERATIONS OF A CERVICAL POLYP

WITHOUT UTERINE INVOLVEMENT\*

ARTHUR STEIN, M.D., F.A.C.S.

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**A**LTHOUGH cervical polyps are exceedingly common after forty, they rarely become the seat of carcinoma. According to Graves,<sup>1</sup> "these small tumors have little tendency to become malignant."

The case I am reporting is of interest first because it disclosed unquestioned squamous cell carcinoma in a cervical polyp, and secondly because thorough examination of the generative organs subsequently removed failed to reveal any evidence of malignancy elsewhere.

Findley<sup>2</sup> states that, while benign polyps may become malignant, he is of the opinion that "many errors in diagnosis made by the pathologist are due to multiplication and stratification of the epithelium."

Walker<sup>3</sup> notes that cervical polyps show a marked tendency to abnormal cell formations: A strong tendency to a downward growth of such cell formations, he believes, "must be considered more than an inflammatory reaction hyperplasia and as bordering very close to a malignant process. From this," continues Walker, "it requires no great amount of further cellular irritation to cause definite neoplastic development."

Stone<sup>4</sup> in 1916 reported 3 cases of polyp of the uterine cervix showing papillary and epidermoid proliferation of varying degrees. In one case there were marked papillary overgrowth and mucoid degeneration of cells in some areas. In another, normal cylindrical epithelium in one area changed abruptly to a slightly thickened stratified layer with considerable papillary downgrowth. The glands in this area were normal. In another area, there were numerous papillary outgrowths below which were numerous irregular metaplastic glands mingling apparently with similar meta-

plastic overgrowths from an underlying hypertrophic gland. The process appeared to be an atypical metaplastic change that could be called "precancerous." In the third case, there were numerous areas in which there were so much metaplasia and overgrowth that it was difficult to say whether or not carcinoma had become established.

Geist<sup>5</sup> in 1922 stated that the cells of polypi of the uterine cervix, as well as those of the body of the uterus, may present various atypical variations without true malignancy. These metaplastic areas may be on the surface or in the glands of the polyp. While not themselves malignant, they may be the starting point for the development of a true malignancy. But Geist expressed the opinion that true malignancy does not exist unless there is infiltration of the base of the tumor and extension into the adjacent tissue.

According to Geist, cervical polyps may be classified according to their histological structure as adenomatous, fibromatous, fibromyomatous and angiomatous tumors. The adenomatous type is rather common in the cervix. Malignant changes, both carcinomatous and sarcomatous, are rare conditions; but they do occur. Geist states that "sarcomatous change is much less frequent than the occasional carcinoma and may arise from any of the connective tissue structures in the growth. These changes are more frequent in the fibromatous or fibromyomatous polyps."

Chisholm<sup>6</sup> in 1923 reported a case of fibroid polyp of the uterine cervix in which irregular bleeding had persisted for two years or more. The tumor was removed with a wide base. It appeared to be fibroid, was not of recent origin, and had no true induration around it. But the pathologist reported "flatcelled cancer." Chis-

\* Submitted for publication March 3, 1930.

holm expressed the opinion that such a growth "is more malignant histologically than clinically."



FIG. 1. Typical carcinoma.

from the beginning. In only 2 of these cases did the growth involve the cervix. In 1 of the cases with cervical polyp, the

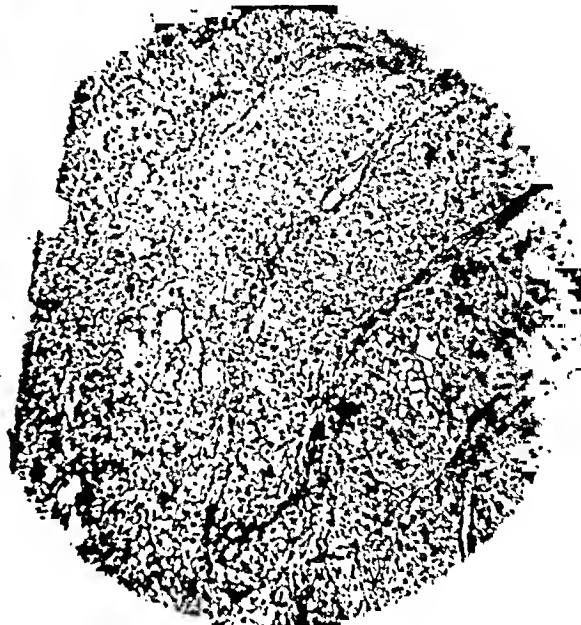


FIG. 2. Same as Fig. 1 from different section.

Geller<sup>7</sup> in 1923 reported 3 cases of polypi of the cervix uteri in which, in some areas, there were several layers of squamous epithelium underneath the layer of normal cervical epithelium covering the polyp which showed irregular carcinoma-like proliferations into the deeper layers of the tumor. All of these polyps showed considerable areas of typical adenomatous formation. Geller did not regard such epithelial proliferations in cervical polyps as indications of true malignant changes, although he conceded that they may later undergo malignant degeneration.

Meyer,<sup>8</sup> in commenting on Geller's article, noted that such epithelial proliferations in cervical polypi are not rare, but that true carcinomatous polypi are rare. The epithelial proliferation does not begin at the base of the polyp, as a rule, but at other points, and not infrequently at the top. Meyer does not regard such epithelial proliferations as of malignant character.

Iseki<sup>9</sup> in 1924 reported 17 cases of polypoid growths of the uterus, some of which were benign polypi that had undergone some degree of degeneration and a few of which were evidently carcinomatous

growth was an adenofibroma, some portions of which showed abnormal epithelial proliferation of a carcinomatous type. The malignant degeneration had begun at the surface of the growth, as the deeper portions were free from any carcinomatous changes. In the second case, a polyp was removed from the cervical canal by the curette. As the histological specimen showed adenocarcinoma, the entire uterus was removed; but only a small remnant of carcinomatous tissue was found in the cervix. The patient remained in good health for seven years after operation. Iseki interpreted this case also as a polyp that had undergone malignant degeneration with very slight invasion of the normal cervical tissues.

Princetau<sup>10</sup> in 1925 reported 2 cases of polypi of the cervix uteri. In each, the polyp was excised. In 1 case, histological examination showed a prickle-cell carcinoma. The uterus was removed, and the cervix was found to be normal; but there was a second polyp in the body of the uterus. In the other case, the polyp was not examined histologically but appeared to be typically fibroid. Yet the patient

developed inoperable cancer of the cervix within a month after removal of the polyp:

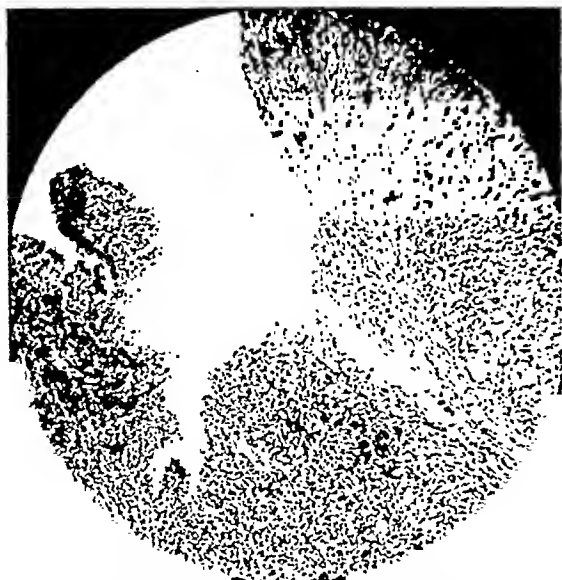


FIG. 3. Probable attachment of polyp showing no carcinoma.

Bishop<sup>11</sup> in 1926 reported a case in which an amputation of the cervix was done because of prolapse and a small polyp that seemed innocent was found in the cervix. Microscopic section of this polyp showed a malignant growth "that took practically the entire section." The epithelial cells were irregular with numerous mitotic figures. Reviewing the literature, Bishop observed that malignant changes in cervical polypi are rarely reported.

In the discussion of Bishop's case, Polak stated that he had seen a number of cases of sarcomatous degeneration in fibroid polyps protruding from the cervix but originating in the body of the uterus.

Fluhmann<sup>12</sup> in 1927 reported an examination of 120 specimens from 100 cases of mucous polypi of the cervix uteri. Twenty-nine per cent of these polypi showed unusual types of epithelium simulating malignancy to a marked degree. Only 1 polyp was found to show definitely carcinomatous changes "with a very immature type of cancer cell which completely overran the whole specimen."

In his study of 100 cases of polypi of the uterine cervix, Fluhmann found only 1 with definite carcinomatous degeneration, none with sarcomatous degeneration. He states that a number of instances of sarcomatous polypi of the cervix are reported, but believes that in these cases "it is likely that we have to deal with a polypous form of the disease [i.e. sarcoma] rather than with secondary changes in a pre-existing polyp." He refers to the case of Kunez and Sachen; but, in this case, the original growths (multiple polypi) were found in the body of the uterus, and the sarcomatous growth (polypoid) which developed about a year and a half after removal of the polypi apparently had its point of origin in the body of the uterus, although it protruded into the cervix.

Seides<sup>13</sup> in 1929 reported a somewhat similar condition to localized cancer in a cervical polyp; namely, adenocarcinoma of the endometrium completely removed by curettage. He cited a paper published by Ladin<sup>14</sup> in 1928 in which 5 cases of adenocarcinoma of the endometrium were reported, in 4 of which the curette succeeded in removing the malignant growth completely. According to Ladin, a total of 34 cases of this nature has been recorded.

#### CASE REPORT

M. L., a widow, aged forty-seven, entered the Lenox Hill Hospital October 7, 1928, complaining of a small bleeding mass at the vaginal opening. She had been married twenty years previously but widowed for fifteen years. She had no children but one miscarriage, at four months, fifteen years previously. During the past year, she had skipped one or two periods on several occasions.

Her illness began in September with general abdominal discomfort. About the middle of the month she began to notice a heavy feeling in the lower abdomen. Soon afterward, she observed a small mass at the vaginal opening, which bled when touched.

The patient was obese; otherwise, general examination was negative. On vaginal examination, the finger met a hard, granular, circumscribed mass attached to a pedicle arising from



the posterior lip of the cervix. It was of a grayish color and bled easily on manipulation. The clinical diagnosis was cervical polyp.

On October 9, the polypoid mass was removed from the posterior lip of the cervix, to which it was attached by a rather broad pedicle. It proved to be hard, granular and somewhat degenerated. The wound in the cervix was cauterized with the actual cautery and the vagina packed with a large gauze tampon dipped in mercurochrome.

On cross section, the polyp appeared to be made up of irregularly arranged yellow bundles separated by dense white streaks. Microscopically, it was composed of tumor tissue showing the structure of squamous cell carcinoma. The cells were arranged in thick clumps and ramifying columns, some of which showed central cores of fibrous tissue or were hollowed out by necrosis. The cells varied considerably in size and staining properties. Many of them exhibited mitotic figures. The stroma was relatively scanty and showed round-cell and leucocytic infiltration.

The pathological diagnosis was squamous cell carcinoma of a cervical polyp.

On October 12, radon seeds were implanted, encircling the field of biopsy and covering its bed.

On October 19, panhysterectomy, bilateral salpingo-oophorectomy and appendectomy were performed. The uterus was found to be freely movable and the parametria were apparently free from malignant involvement. In the outer third of the left parametrium, however, there was a gland the size of a cherry pit; also, a smaller gland near the left common iliac artery.

Radon seeds were implanted in the parametria and the peritoneum was closed over the stumps and the parametria with the exception of the central opening, through which a drain was allowed to protrude into the vagina. The abdomen was closed in four layers.

The patient made an uneventful recovery.

Notwithstanding the most careful and minute examination of the structures removed at operation, no evidence of malignant extension from the cervical polyp could be found. The positive findings were chronic cervicitis and endocervicitis, glandular hyperplasia of the endometrium, uterine fibrosis, corpus luteum cyst of one ovary, adenofibroma of the opposite ovary, chronic catarrhal salpingitis, chronic appendicitis and acute periappendicitis.

## DISCUSSION

Contrary to the general impression, degeneration of cervical polyps is more likely to be carcinomatous than sarcomatous. Although sarcomatous polyps are not rarely found to be protruding from the vagina, they are usually found to arise from the body of the uterus, not the cervix.

Most of the discussions in the current literature are concerned with the peculiar cellular formations in cervical polypi that may simulate malignancy without the clinical concomitants of the disease. In the case I am reporting, the microscopic picture was too distinctive for us to question the diagnosis of carcinoma. Yet the disease appeared more malignant pathologically than clinically.

Commenting on the confusion existing with regard to the carcinoma-like cellular formations existing in cervical polypi without actual malignancy, Kerr, Ferguson, Young and Hendry<sup>15</sup> make the following statement:

In some cases a mucous polypus may become malignant, the connective-tissue stroma becoming sarcomatous or the epithelium becoming carcinomatous. These changes are probably rarely present, though it is notorious how frequently the pathologist finds difficulty in pronouncing whether the tissue changes in such cases are due to chronic inflammation or malignancy.

## SUMMARY

Carcinomatous degeneration of cervical polypi is of rare occurrence. A case is reported of a widow, aged forty-seven, in whom pathological examination of the excised polypus showed it to be the seat of a typical squamous cell carcinoma. Yet, when panhysterectomy and double salpingo-oophorectomy were performed, the most minute examination failed to disclose any evidence of malignancy elsewhere in the reproductive tract. Apparently, carcinoma of cervical polypi is more malignant pathologically than clinically.

[For References see p. 135.]

# NEW INSTRUMENTS

## A ONE-MAN PNEUMOTHORAX APPARATUS\*

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**P**HTHYSIOLOGISTS who have occasion to give pneumothorax treatments at the bedside or at the home of the patient are familiar with the inconveniences and the impracticability of the present-day apparatus. The instrument to be described here can be operated by the attending physician without an assistant, and without interfering with sterile technic. It fits into a box 11 in. by 3 in. by 2½ in., containing a compartment with a metal box for the transport of the needles, syringes and connecting tubes, sterilized and ready for use. The box can be easily carried in the ordinary physician's bag, leaving room for towels, gloves and other accessories of the operation.

The apparatus consists of a three-way stop-cock connected with rubber tubing leading to the chest, the manometer and a 15 c.c. air pump. Between the pump and the stop-cock are inserted a cotton air filter and a rubber balloon. The latter serves as a reservoir for measured dosages of air and as a buffer, in case the pressure becomes suddenly too high or the point of the needle becomes accidentally misplaced. Two three-way stop-cocks may be added to the apparatus, one on either side of the rubber balloon, to shunt the air around it in case it is necessary to administer accurately measured dosages of air at high pressures. Their use is explained in separate diagrams.

The manometer is composed of a glass tube 26 cm. long, calibrated in centimeters and a water reservoir 10 cm. long and 3 cm. in diameter.

### USE OF THE APPARATUS

*Refills.* Water is placed in the reservoir to a depth of 5 cm. and the graduated glass tube is inserted into it. The stop-cock is placed in such a position that the three tubes are in communication with one another. The balloon must be empty of air. The instrument table is laid out with the necessities of the operation. The glass connection on the end of the chest tube is sterilised with alcohol and placed on a corner of the table. The pump is placed beside it and covered with a sterile gauze compress. The needle is inserted into the chest in the usual way and placed in communication with the rubber connecting tube from the sterile metal box. This is then joined to the chest tube by means of the previously cleaned glass pipe. The manometer immediately registers the pressure in the chest if the lumen of the needle and tubes is free.

When a good reading is obtained, the needle is held with one hand, while with the other, 100 c.c. of air are forced into the balloon by seven strokes of the pump. The manometer falls; the air is gradually taken up by the negative pressure of the chest and the manometer rises again. The process is repeated until a satisfactory quantity of air has been given or a satisfactory pressure has been attained. The operator may at any time discontinue the administration of air, make an attempt in a new site or clean the needle canal, without endangering the perfection of his technic.

*Initial Treatments.* As a general rule

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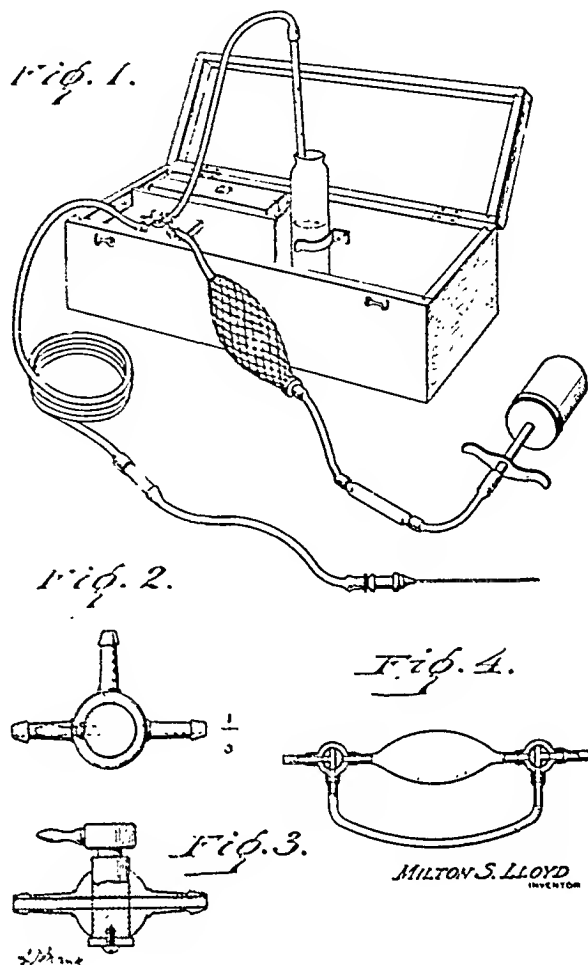
initial as well as follow-up treatments may be given with the technic described here. In case adhesions and a poor fluctuation are anticipated, the stop-cock is turned so that the chest is in communication with the manometer only. Minor variations and positive pressures are then accurately recorded. Any desired amount of air, up to 180 c.c., may then be placed in the rubber balloon and held in reserve. As soon as a satisfactory reading is obtained, the stop-cock is returned to the original position and air begins to enter the chest. This may also be done without an assistant by using a sterile compress to seize the stop-cock.

*Positive Pressure Pneumothoraces.* On rare occasions it is found advisable to maintain a pneumothorax at a positive pressure. The author in his experience, has never found it necessary to keep up a pressure of more than +10 (true). Pressures up to this level may be satisfactorily given with this apparatus, in the following way.

The manometer reservoir is filled with water to a depth of 10 cm. instead of 5. The stop-cock is turned to the position in which the manometer and the pump, only, are in communication with each other. Air is then forced into the balloon, until a positive pressure, corresponding with the optimum for the patient, is registered in the manometer. The chest and manometer, only, are then placed in communication. The needle is inserted and a reading is obtained. The three parts of the apparatus are then placed in simultaneous communication and air is pumped into the chest until the pressure returns to the original level. In this way the dosage of air can be accurately measured, since all air delivered by the pump, between the two corresponding positive pressure levels, must have entered the chest.

If higher pressure than +10 is desired the air can be shunted around the balloon by the system of stop-cocks shown in the diagram. It is then delivered directly from the pump to the chest at any degree

of positive pressure desired. The author has never found it necessary or desirable to use this system, although some critics



advise its use. In the accompanying diagram Figure 1 shows the apparatus set up and ready for use. Figures 2 and 3 show the three-way stop-cock viewed from above and from the side. Figure 4 shows the system of stop-cocks used for shunting the air around the balloon.

#### TESTING THE APPARATUS

*The Manometer.* To test the manometer, place the chest tube and the manometer only in communication with each other, create a negative pressure in the system to a level of about -15, pinch off the chest tube and allow to stand. If the pressure is maintained, the manometer does not leak.

*The Pump.* When the apparatus is in perfect working order, thirteen strokes of the pump should create a pressure of +5 in the closed rubber balloon. Turn the

stop-cock so as to place the pump and manometer in a closed system, with the manometer at zero and water in the reservoir to a depth of 5 cm. Force thirteen strokes of air into the balloon. If the pump is functioning properly, bubbles of air will appear from the bottom of the calibrated glass tube at the beginning of the thirteenth stroke.

#### DEFLATIONS

The apparatus may be used for deflation by inserting a Y glass or metal pipe into the tube system leading to the chest.

The stem of the Y is directed toward the chest and the two branches to the manometer and an aspirating pump or syringe. In this way either air or liquid may be taken from the chest, while the pressure is under observation. It has also the advantage that there is no danger of infecting the apparatus by aspirating pus or infected effusions into its parts.

While this device was worked out as an original idea, the author wishes to acknowledge priority, in part of the design, to Prof. Jousset of Paris, whose apparatus he has recently had the pleasure to inspect.



### SKIN CLAMP HOLDER\*

E. G. C. WILLIAMS, M.D.

DANVILLE, ILL.

A TUBE clamp (A) was soldered to a brass upright piece (B) which was cast into a lead block (C) and used clamps at (D) by a wire cutter (E) the clamps are easily lifted off the clips by the self-closing forceps (F). By using two

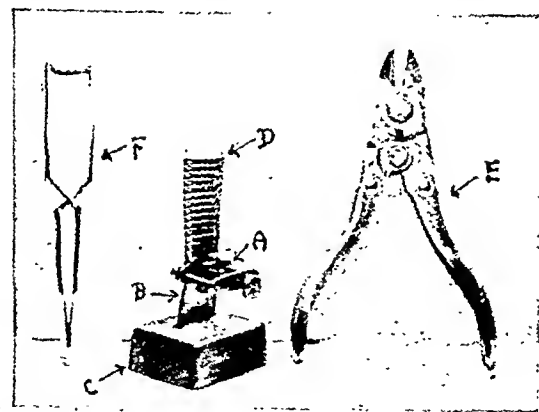


FIG. 1.

to hold the clips of skin clamps during the closure of wounds. The weight of the block of lead holds the clips so firmly that after the long wires have been cut off close to the

or more forceps an assistant can keep them filled and ready for the operator. The system saves time at the end of an operation when time always seems most valuable.

\* Submitted for publication March 10, 1930.



## ✓ CASE REPORTS ✓

### COMPLICATIONS FOLLOWING THE USE OF THE GOLD SPRING PESSARY\*

CARYL POTTER, M.D., F.A.C.S.

ST. JOSEPH, MISSOURI

IN the past before gynecology offered the various perfected operative procedures for correcting malpositions of the uterus, the various forms of pessaries were valuable therapeutic agents for relieving symptomatic displacements. This era was popularized by the ball and disc pessaries and subsequently, by various forms of the Smith-Hodge pessary. While these were in place, symptoms were often relieved, but returned after their removal, thus demonstrating that they were palliative rather than curative. They were also used to accentuate the palliative effects of local treatments, such as hot douches and tamponade. At a time when gynecological surgery had not been perfected, and operative procedures were attended by grave risk, and in patients who had an antipathy for surgical procedures, pessaries enjoyed a well-earned popularity. They are still worn, with some relief and with much less frequency, by a number of patients who refuse to submit to surgery.

Another era of the popularity of the pessary began with the introduction of the stem, which has been advocated, and does relieve many cases of acute antifixion with stenosis of the cervical canal from muscle spasm, having symptoms of backache and severe dysmenorrhea. This form is now used by many gynecologists and surgeons, and although it is a complete or partial failure in a fair percentage of patients, it does relieve some permanently and many temporarily. It should be left in place for from four to six weeks to obtain the best results.

With the advent of popular literature, recommending birth control, there have arisen many methods for contraception, advocated by social organizations, made up of faddists and many well meaning individuals who, with their various theories for limiting the number of children in certain families, have not always taken into consideration the harmfulness of some of the methods proposed to thwart nature's determination to propagate the race.

In response to the public's interest in birth control, one of the most popular of the current methods advocated for preventing conception has been the introduction of some form of stem or button disc pessary into the cervical and uterine canal. The so-called gold spring pessary is the latest improvement on these various instruments. Illegitimate faddists have been its strongest advocates, because the procedure has become the means of adding very substantial remuneration to their otherwise doubtful and unscrupulous practices. Not only has it become a very popular instrument in their hands, but there are a large number of none too scrupulous members of the medical profession who are advocating this supposedly harmless but, as will be shown later, all too dangerous instrument. Its simplicity of introduction and the general demand for some form of birth preventative, along with its possibilities for financial reward, have given it general popular favor. Some surgical instrument houses have even made it a feature in their current advertising sheets, with the result

\* Submitted for publication March 17, 1930.

that one is amazed to find that not only are a large number of women wearing it, but the number is increasing very rapidly. Some practitioners are passing the word about that they are inserting it, and many women are making monthly visits to have the instrument removed, cleansed and replaced before or after each menstrual cycle.

It is not the purpose of the writer to argue for or against the number of children that should fall to the lot of any woman to deliver and raise; but we should reckon ourselves remiss as physicians if we did not warn the profession and laity that the wearing of this instrument, instead of being a harmless and sure preventative of conception, may not only cause irreparable damage to the female generative organs, but a complication of pregnancy, much more dangerous, if not as fruitful, as the usual productive labor.

In the past 3 years I have encountered 3 cases of ruptured ectopic pregnancy, and a physician in a nearby city has informed me that one had come under his observation in patients who were carrying the stem and the ectopic fetus at the time of examination. The rupture had already taken place in 2 of these, and in the case herein reported, the stem was removed at my first examination, but I did not discover at the time that the patient had an extrauterine pregnancy. The diagnosis was made later after the embryo had aborted through the fimbriated end of the tube. The case, herein reported, will show that this was part of an unusual syndrome caused by this so-called harmless device.

That fecundation will rarely take place in the presence of a foreign body in the uterus has long been recognized. The introduction of something into the cervical or uterine canal has always been the most frequent method used to interrupt pregnancy. The strong, positive chemotaxis between the ovum and spermatozoon has been nature's means of propagating the race. The very construction of the spring pessary and its position *in utero* make it an ideal scaffold

for the transit of the spermatozoon through the uterus into the tube. Even the small rings on the end tend to hold open the atria of the tubes at each uterine cornu. By the springing open of the instrument the uterine canal is held open.<sup>1</sup>

The other types of complication observed are the many varieties of pelvic inflammatory disease: vaginitis, erosions of the cervix, endometritis, metritis and chronic salpingitis. In the presence of gonorrheal endocervicitis, the pessary is likely to cause an ascending infection, resulting in an acute salpingitis, pyosalpinx or a general metritis. Some women argue that they use pessaries only before and after the menses and leave them out for about two to two and a half weeks of each month. Such a course not only does not insure against uterine pregnancy, but their presence during this period of congestion makes the generative organs much more susceptible to local and ascending infections.

A great many women are very careless about their vaginal toilets, and the care of these pessaries is no exception to the rule. Although some have them removed, cleansed, and re-inserted at monthly or bi-monthly intervals, many are left in place for several months. One woman who was examined had the usual pelvic syndrome, the most prominent symptom of which was profuse leucorrhea. I removed a corroded metal pessary, which had remained *in situ* for several months. It had been introduced by one of the faddists when he was consulted for some method to prevent conception. She was told that he would introduce a small instrument into the uterus for this purpose, but was given no instructions for its removal or cleansing. He was informed that she intended to move in a short time

<sup>1</sup> Since this article was written one patient has come under my observation who was seven months pregnant and another under the care of one of my colleagues who removed one of these pessaries at the time of delivery. The latter had not had a physician until she went into labor. In the first case the pessary was removed at seven months and she went to normal term and gave birth to a normal child. These are definite clinical evidence that the instrument is not a certain preventive.

to another city. Whether from ignorance, fear of being exposed by some legitimate physician if the instrument were soon discovered, or lack of knowledge as to whom she should be referred, no instructions had been given regarding the kind of instrument that had been inserted or for her after care. At my first examination a foul-smelling, eroded stem that had been in the uterus for months was removed. The patient had an acute pelvic inflammatory disease, accompanied by leucorrhea, lower abdominal pain and tenderness, fever and leucocytosis. She was sent to the hospital, where ice caps were applied to the lower abdomen and frequent hot douches given until the acute symptoms subsided. Following her discharge from the hospital local treatments were given for several months. When treatment was discontinued her condition seemed satisfactory, but the salpingitis may have caused a permanent sterility, which was the desired end, even though the means employed had caused pathological changes in her pelvic organs, which had made her a pelvic invalid for several months. It is possible that her reproductive organs may have been affected to the extent of causing future acute exacerbations or a more or less chronic symptomatology. Who can say when a pelvic inflammatory disease is cured?

The following case illustrates a series of complications, resulting from its use, and should serve as a sufficient warning:

Patient, married, aged twenty-seven.

*Complaint:* Tachycardia. Nervousness. Moderate constipation. Menorrhagia. Metrorrhagia.

*Family History:* Two children, youngest fourteen months, father and mother, sister, 1, brother, 1, and husband, forty-three years, living and well. No goiter, cancer, tuberculosis, Bright's disease or diabetes in the family.

*Past History:* Measles, mumps, whooping cough. An attack of influenza in 1919 and 1926. No tonsillitis. No operations. Fullness of the throat since she was in high school. Was treated for goiter by her family physician at this time. During her adolescence and before marriage, she had several attacks of indigestion,

with pain in the right lower quadrant. Was told at one time she had had an attack of appendicitis.

*Catamenia:* Onset at twelve years. Interval three weeks and duration six days. Four to five napkins daily. No clots. No leucorrhea. Married five and a half years. Two children, youngest fourteen months. No miscarriages, no lacerations, deliveries without forceps.

*Present Illness:* For the past year menstrual flow has been very much increased. Duration, seven days, 5 to 6 napkins daily. Has been very nervous, at times has had tachycardia. Dysmenorrhea and tachycardia have been more severe for six weeks. Since that time pulse rate has been 120-130 a minute, very much more nervous, face and chest flush easily, noticeable trembling of her hands. There has never been any prominence of the eyes. On account of fear of an exacerbation of her goiter symptoms, for which she had previously been treated, and of becoming pregnant, she had visited an osteopath, who had introduced a disc spring pessary into the uterus to prevent conception. She says this instrument is still in place.

*Physical Examination:* Flushed face and mucous membranes. Pulse rate 120 at rest. Head: teeth excellent. Tonsils small. Neck: has a definite, moderately enlarged goiter, lobulated. Chest: heart sounds normal, but rate increased. Lungs, clear. Abdomen: no masses, no tenderness. Gynecological: introitus marital, no lacerations, some erosions of the cervix. A gold disc spring pessary was removed at examination. Purulent discharge from the cervix. Smear shows streptococci and diplococci. Gram positive. Not biscuit shaped. Slight enlargement in the right fornix. Thought to be an enlarged ovary. No fixation. Knee jerks increased. Fine tremor of the fingers. Anal sphincter very tight, may account for part of her constipation. Basal metabolism, +60.

*Diagnosis:* Goiter, adenomatous. Endometritis, hyperplastic. Hyperthyroidism. Erosions of the cervix. Chronic constipation.

*Operation:* Subtotal thyroidectomy, through collar incision. One piece of packing for drainage. Closure, layer by layer. Muscles were not divided.

Dilatation and Curettage.

Dilatation of sphincter ani.

*Pathology:* Goiter was moderate size. There were several diffuse adenomas throughout the thyroid gland. Curettings were extremely abundant, granular in type, as profuse a type



of chronic, hyperplastic endometritis as I have ever seen.

#### **PATHOLOGIST'S REPORT**

*Gross Examination:* The curettings consist of small shreds of endometrium and blood clots.

The thyroid tissue weighs 54.5 gm. and is in two sections. Both sections are uniformly and diffusely enlarged. The cut surface shows a translucent, shiny, brownish, honeycomb appearance. Cysts and degenerative changes are not found. Circumscribed adenomatous areas are found.

*Microscopic Examination:* Sections from the endometrium show chronic inflammatory changes and glandular hyperplasia.

The sections from the thyroid show diffuse adenomatous colloid goiter. The acini vary much in size and shape and are filled with colloid. Some acini are quite small and others are large and cystic. The pathology is that of colloid adenomatous goiter.

*Pathological Diagnosis:* Endometritis, chronic, hyperplastic. Colloid goiter, multiple adenomata.

*Course:* Wound healed by first intention. Packing removed the second day. All sutures removed the sixth day. At time of discharge, there were a few drops of bloody serum squeezed through drainage tract. Four days following operation, she had drawing sensations in both hands, suggestive of a slight parathyroid tetany. There was also some slight drawing of the toes. Marked dyspnea and apprehension. The following day she had another attack, similar to the first, except that it was more marked. She was given 6 doses of 15 grs. each of calcium lactate every eight hours and the third day an intravenous injection of 10 c.c. of 5 per cent calcium chloride solution. She had no further trouble during her hospital course. Discharged the tenth day.

*Interval Note:* Patient came to my office two days following her discharge, January 15, 1929. The following day she had a rather severe attack of tetany, arms, hands and forearms undergoing spastic contractions. Was relieved by calcium lactate and morphine. Came to my office the day following, and received an intravenous injection of 10 c.c. 5 per cent calcium chloride. No subsequent attacks of tetany. Wound had completely healed. Ten days following discharge from the hospital, she menstruated profusely. Color was slightly dark. This was unusual, due to the fact that

she had had a curettement at the time of her goiter operation.

*Present Illness:* On January 30, 1929, exactly three weeks after her goiter operation, she had severe abdominal cramps, which caused her to cry out with pain. The onset was at 3:30 P.M. I was called over the telephone, and told that she was having drawing sensations in the legs and arms, with contraction of the fingers of both hands and slight drawing of the toes. The abdominal cramps were severe. I told the family to give her 15 grains calcium lactate, which she promptly vomited. This was repeated, and she vomited again. At 7:00 P.M. I was called again, and told that the abdominal cramps had become more severe, that she had been given morphine without relief, that she had arisen from bed to go to the bathroom when she became deathly pale and fainted. I immediately visited her at her home.

Was first struck by her marked change in color since the time of my office examination a few days previous. At that time the color of her skin and mucous membranes was good, and pulse was 88. She had felt very much better than at any time previous to or following her goiter operation. Skin and mucous membranes are now blanched. Sighing type of respiration. Pulse rate 130-140 and can hardly be palpated. Lies in bed with her thighs flexed, supporting the abdomen with both hands and complaining of colicky pain in the right lower quadrant.

*Physical Examination:* Head: teeth in excellent condition. Tongue, pharynx and tonsillar region pallid. Beads of cold sweat on the upper lip. Neck: goiter incision has healed by first intention. No palpable glands in the neck. Chest: sighing type of respiration. Excursion shallow. Lungs, breath sounds normal. Heart sounds weak. No murmurs.

*Gynecological Examination:* Introitus marital, cervix about normal size, slightly soft. Dark, bloody discharge, moderate in amount, from external os. Fundus well developed, but seems about normal size; probably slightly enlarged. A soft mass can be felt in the right fornix extending from above Poupart's ligament down behind the uterus and bulging into the cul-de-sac. This mass is not rigid, but has a doughy consistency. On manipulation of this, she complains of a great deal of pain. Feels like fainting.

Extremities cold. Reflexes normal. There is no evidence of any tetanic contractions of the muscles of the feet or hands.

*Diagnosis:* Ruptures ectopic pregnancy. Sent to the hospital in an ambulance.

*Operation:* Midline, 6 in. subumbilical incision. Outer half of the right tube ligated and removed. Appendectomy by the usual inversion method. A v-shaped portion of the left tube was removed at the left horn to produce sterility. Blood in the abdomen was sopped up by means of sponges, squeezed through a gauze protected funnel into a beaker, containing citrate of soda. Five hundred c.c. of blood were recovered in this manner and autotransfusion of citrated blood performed by injecting it through a needle into the basilic vein. Closure layer by layer, without drainage. One thousand c.c. of normal saline containing 100 gm. glucose were given in the muscles of the posterior axillary fold. Also, active stimulation started.

*Pathology:* The outer half of the tube was very much dilated and the embryo had extruded itself through the end of the right tube, a complete tubal abortion. The embryo was intact, surrounded by a sac filled with amniotic fluid. In size it appeared to be about two to two and one-half months. When the sac was opened, clear amniotic fluid was discharged. The appendix was long, congested, bound down by fine adhesions. There were about 1½ pints to 1 quart of free blood and blood clots in the cul-de-sac and lower abdominal cavity. The gall bladder was examined, found flaccid, contained no stones.

#### PATHOLOGIST'S REPORT

*Gross Examination:* Specimen, tubal abortion. The outer portion of the fallopian tube is dilated and ruptured and shows a small embryo approximately two months old. The specimen is well developed, and rests within an amniotic sac. The embryo is attached to the fallopian tube by an umbilical cord and placenta. The fallopian tube in this area has a thick wall and shows marked hyperplasia of mucous folds. The peritoneal surface of the tube is somewhat granular and the superficial blood vessels are moderately injected.

The appendix measures 8.5 cm. in length. Its wall is thick, firm and fibrous. The superficial blood vessels are slightly injected. The lumen is present.

*Microscopic Examination:* Sections from the appendix show catarrhal mucous glands with small round cell infiltration and lymph tissue increase. The submucosa is thickened and shows fibrous tissue increase. The muscle

layers are thickened and show fibrous tissue increase. The serosa is thickened. The superficial blood vessels are slightly congested. Moderate eosinophile cell infiltration is found.

*Pathological Diagnosis:* Tubal abortion. Appendicitis, chronic.

*Course:* Very stormy for twenty-four hours. Pulse rate mounting to 150, very weak at times. Clysis repeated. The day following operation, she was very much distended, complained of gas pains, but there was practically no rigidity of the abdominal wall. The gas was relieved by repeated enemas and pituitrin. The second day, calomel was given, followed by two sedlitz powders.

Feb. 3, 1929, condition very much improved.

Feb. 4, 1929, very much better. Has had no suggestion of tetany since the operation for ectopic pregnancy.

*Examination:* Sept. 15, 1929, normal convalescence. Pulse rate 76. Has had no more attacks resembling tetany.

*Check up Note and Comment:* In the review of this case, the following points are of interest and bring out this sequence of events:

Patient, who had had a goiter from early adolescence, for which she was treated palliatively, married and had two children. During these pregnancies she had a more or less severe course, was nervous, and showed some flare-up of her goiter. Following the birth of the last child, she decided to use means to prevent further conception, and visited an osteopath, who introduced a gold spring pessary to prevent conception. During her whole menstrual history, from the onset until the present, she had had menorrhagia and metrorrhagia without any apparent change in the cycle or character of the flow. Having been assured that the presence of this pessary would prevent conception, she became careless. The uterus would not become impregnated on account of the presence of a foreign body in the uterine canal, but the spermatozoon propelled itself past the uterine canal, and impregnated the ovum in the tube. As soon as she became pregnant, she developed an acute hyperthyroidism, with a very rapid course, increased pulse rate, tremor, nervousness, flushing, sweating and increased basal metabolism. Whether or not the slight sickness at her stomach was due to her goiter is conjectural. The presence of the foreign body in the uterus stimulated uterine contractions, and also probably increased peristalsis in the impregnated tube. The increased peristaltic

wave forced the ovum toward the end of the tube, and what was probably an extrauterine pregnancy became a tubal abortion. At the time of the goiter operation, the posterior capsule and parathyroids were left undisturbed. A generous portion of the posterior surface of the gland in the neighborhood of the parathyroids had been left, and there was no disturbance of the recurrent laryngeal nerve, because the patient showed no subsequent disturbance of the voice, which was additional proof that there had been no interference with the anatomy or blood supply of the parathyroids. Regardless of this, however, she developed symptoms of postoperative parathyroid tetany, the cause for which was not discovered until the ruptured extrauterine pregnancy was discovered. This was relieved by the administration of calcium salts intravenously and by mouth. It was probably due to an endocrine upset, caused by her pregnancy, with a disturbance of the internal secretions of the ovary, thyroid gland, parathyroid and probably other endocrines.

In no other way can the tetany be explained. Pregnancy causes a change in the metabolism of the glands of internal secretion, especially of the thyroid, mammary glands, ovaries and parathyroids. We often see calcium metabolism upset during pregnancy, due to the activation or insufficiency of the parathyroids. This is often exhibited by hypocalcemia, deficient calcium in the breast milk, falling out and brittleness of the teeth, with chipping off of the enamel. It would be interesting to check the blood calcium in a series of pregnancies.

Since the removal of the ectopic there have been no symptoms or signs of parathyroid disturbance or tetany. The history of long existing attacks of indigestion, with pain in the right lower quadrant, were probably caused by the appendix, the pathological report

showing a chronic appendicitis. The clinical pathology was sufficient indication for its removal, which added very little hazard to the operation. On account of her recent operation for goiter, the hyperthyroidism during pregnancy, long standing history of nervousness and metabolic disturbances, accentuated by a fear of pregnancy, and the fact that there is an inclination on her part to employ dangerous methods for contraception, it was thought best to sterilize her by removing a v-shaped portion of the unaffected tube.<sup>1</sup>

### CONCLUSIONS

Due to modern economic conditions, the high cost of living, the love of women for luxury instead of families and domestic life, crowded living conditions, growing propaganda for birth control, and increasing tendency, not only illegitimate practitioners to use these instruments, but also for men in the regular profession to surrender to the demands of married folk to use dangerous methods to prevent conception, this era of the use of the so-called harmless gold pessary has come into vogue.

That its so-called harmless character has been disproved is amply demonstrated by the common incidence of extra-uterine pregnancy and pelvic inflammatory disease accompanying or following, its use.

<sup>1</sup> Since this article was written two of my Colleagues, Dr. John I. Byrn and Dr. Frank X. Hartigan, have reported at staff meetings 2 cases of general peritonitis, confirmed by autopsy, caused by the introduction of this instrument by the same osteopath. In both instances the pessary had been to prevent conception and there was no pathological evidence that a pregnancy existed at the time of or subsequent to its introduction. These reports clearly throw the danger and seriousness of the procedure even in the absence of pregnancy.



# PERFORATED TYPHOID ULCER

## CLOSED BY PRIMARY ENTEROSTOMY\*

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THE following case of perforated typhoid ulcer is of interest; first, because while it is now a comparatively rare condition, it must be considered in the differential diagnosis of the acute abdomen; and second, because this case presents very interesting and unusual features.

Mr. P. L. C. white, male, nineteen years of age, was admitted to Wesley Memorial Hospital, February 16, 1929. His chief complaint was abdominal pain and tenderness. The previous history was essentially negative until two weeks before admission; during this time, he had had a daily rise of temperature, and was thought to have malaria. He had been treated with quinine, but was not confined to bed.

At midnight (approximately twelve hours before admission) he was seized with a sudden and violent abdominal pain, which was immediately followed by nausea and vomiting. He was seen by his family physician and given a dose of magnesium sulphate. The pain continued, and the following morning he was seen by a consultant, who diagnosed his condition as acute peritonitis. He was admitted to Wesley Memorial Hospital at noon of the same day, and was seen by me two hours later.

The physical examination was essentially negative, except that he appeared to be acutely ill, his temperature was 104, with a pulse of 110 and the abdomen was board-like and tender throughout. The urine examination was essentially negative. The blood count revealed a leucocytosis of 22,000, with 95 per cent polymorphonuclears. A diagnosis of acute peritonitis was made, and immediate operation advised.

Under ethylene anesthesia, a right rectus incision was made, and when the peritoneum was opened, fecal material escaped from the wound. An exploration revealed a perforation in the ileum, the size of a lead pencil, approximately 10 in. from the cecum. The abdominal cavity contained fecal material, which was

still escaping from the perforation. (This was probably increased by the dose of magnesium sulphate). In addition to the perforation, there

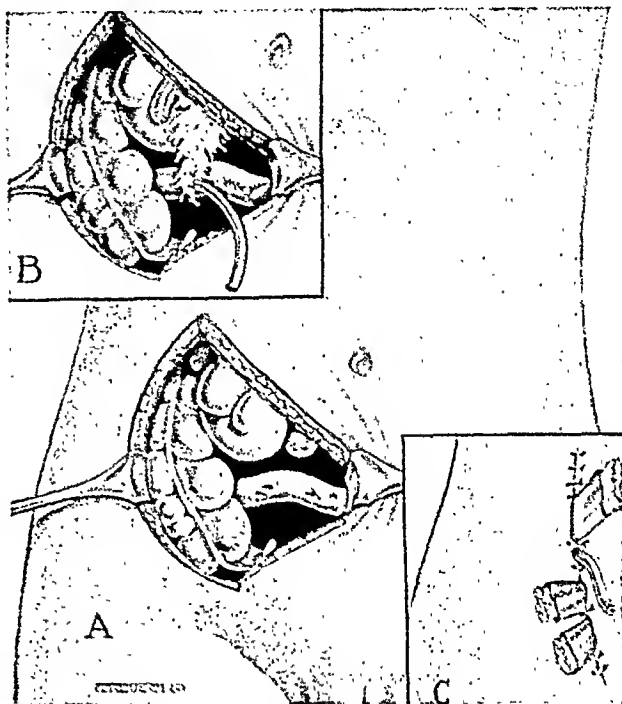


FIG. 1 (A). Perforation in ileum with two necrotic areas just above. (B). Enterostomy tube placed in perforation with portion of omentum sutured around tube. Two necrotic areas reinforced by Lembert sutures. (C). Wound lightly closed with two cigarette drains in pelvis and one in right kidney fossa. Enterostomy tube appears in center of wound.

were two necrotic areas about to perforate. A No. 18 catheter was placed in the perforation with the end toward the cecum, and fixed with two purse string sutures of chromic catgut. The two additional necrotic areas were reinforced by Lembert sutures. The head of the table was then raised, and by use of suction and moist sponges, the upper abdomen was cleansed as thoroughly as possible. He was then placed in the Trendelenburg position, and the pelvic cavity treated likewise. Following this, drains were placed in the pelvis and right kidney fossa. The peritoneum was sutured lightly and through and through sutures of silkworm gut completed the closure.

\* From the Surgical Department of Emory University. Submitted for publication March 25, 1930.

**Postoperative Course:** The enterostomy tube functioned almost immediately, and during the first twenty-four hours, drained more than a gallon of fecal material. His convalescence was remarkably smooth, with surprisingly little distention. The enterostomy tube was expelled on the fifth day, and following this, the enterostomy opening closed promptly. The subsequent treatment was directed along the usual lines prescribed for localized suppurative peritonitis.

#### DISCUSSION

It is believed that this case offered ideal indications for a primary enterostomy. It was a quick and efficient method of closing the perforation, at the same time protecting the two additional necrotic areas, and was the best method of insuring against an ileus. The tube functioned immediately, and the enterostomy closed promptly after the tube had been expelled.



## CARCINOMA OF CERVIX UTERI

WITH SPECIAL REFERENCE TO ITS OCCURRENCE IN EARLY LIFE\*

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NORFOLK, VIRGINIA

**C**ARCINOMA of the cervix because of its frequent occurrence is of especial interest to the profession. It is not definitely known whether carcinoma of the cervix is on the increase or not, though it is believed by many that it is, and the literature strongly suggests an increase; but we do know that many more cases are being diagnosed now than formerly on account of increased interest and because of increased knowledge of the subject of carcinoma on the part of both the profession and laity.

There is no subject in the realm of medicine which should receive greater interest on the part of the profession than carcinoma. To diagnose these cases early and thereby reduce the number of deaths from this condition, will require even greater interest on the part of the profession. The important fact for us to keep in mind is *early diagnosis*, and early diagnosis will be brought about only by keeping in mind the conditions that predispose to cancer; in other words keeping in mind the precancerous conditions. By careful observation and treatment of these precancerous conditions the incidence of cancer will be reduced, and the cases developing cancer will come under observation earlier.

#### INCIDENCE

Carcinoma of the cervix is seen most often from forty to fifty-five years of age, but it also occurs in both the young and old. Therefore, to think of it only in what has been termed the cancer-age is misleading. Schmitz gives the incidence of cancer of cervix at various age periods as follows: twenty-one to thirty, 4.2 per cent; thirty-one to forty, 18.2 per cent; forty-one to fifty, 35 per cent; fifty-one to sixty, 33.2 per cent; sixty-one to seventy, 8.9 per cent; forty-six to fifty-five, 41.5 per cent; forty-one to sixty, 67 per cent. According to the literature I have been able to find, cancer of the cervix occurring during the first twenty years of life is rare.

Adolph Bonner reports a case of carcinoma of the cervix in a girl of thirteen (I wish to acknowledge that the greater part of the statistical data on the incidence of cancer of the cervix in early life in this paper was obtained from his report). He made a very thorough search of the literature on the occurrence of carcinoma of the cervix in early life and he was able to find only 2 cases younger than his own that could be considered authentic. Glocker reported a case of adenocarcinoma of the cervix in a girl of seven. Gayraud

\* Read before the Norfolk County Medical Society, June 9, 1930.

reporting on the literature up to 1911 was able to find only 3 cases in the first twenty years of life. They were the cases reported by Tschoop, Eckhardt and Ganghofer. Gusserow's statistics on 3471 cases show only 2 cases under twenty years of age. Koblanck reporting on 6354 cases was able to find only 2 cases under twenty years of age and they were included in Gusserow's report. Schauta reported a case of cancer of the cervix in a girl of seventeen; Frankel, Cragin and DeRouville each reported a case in patients aged eighteen. Taylor and Peightal in their report on cancer of the cervix for the Roosevelt Hospital for 1924 gave 2 cases occurring in their services under twenty years of age, one patient being twelve years old and the other being nineteen. Darnall reported a case in a colored girl of twenty who gave no history of pregnancy. Kehrer and Neumann reported a case in a child sixteen months and Arthur H. Morse reported a case in a child ten years of age, both of these cases being reported as carcinoma of the genital tract, and from their pathological reports it is not believed that either case had its origin in the cervix, but probably originated in the fundus. Perhaps a number of other cases have been reported as occurring during the first twenty years of life, but I was unable to find them. The diagnoses in some of the cases mentioned here have been questioned because of no laboratory report or because the laboratory report itself has been doubted. From these reports it is evident then that cancer of the cervix occurring during the first twenty years of life is rare, but it does occur and that fact should be kept in mind. There seems to be an increasing number of cases reported as occurring before thirty years of age.

It is believed that cancer of the cervix occurs only in cervixes that have been the seat of inflammatory disease or in cervixes that have had some traumatic lesion (the trauma usually resulting from pregnancy). It has been estimated by some of the older writers that about 95 per cent of the cases

of cancer of the cervix occur in women who have been pregnant and that the majority of them have had more than one pregnancy. The more recent reports indicate that a considerably smaller number than 95 per cent of the women having cancer of the cervix, have been pregnant. Schmitz found in 400 cases of cancer of the cervix that 14.75 per cent occurred in nulliparas and 19.5 per cent occurred in primiparas. He also found that the percentage of pregnancies is about the same in women of the so-called cancer age who do not have cancer, as it is in those who have cancer of the cervix; he therefore concludes that probably chronic infection and bacterial invasion predispose to cancer of the cervix, and that the number of pregnancies probably plays a secondary rôle as a predisposing factor.

Cancer of the cervix may begin in the squamous epithelium of the cervix, in the endocervix proper or in that portion of the cervix where there is a transition from the squamous epithelium to the true mucous cells of the endocervix. Cancer starting in the squamous epithelium of the vaginal portion of the cervix will be of the true squamous cell type, whereas if the beginning is in the endocervix or in the transitional epithelium, it will first begin as an adenocarcinoma; but as it grows it often takes on the squamous cell variety. Occasionally we find the adenoid type persisting, but the great majority of cases when seen are of the squamous cell variety. Cancer originating from the squamous epithelium of the cervix grows outward as a mass into the vagina and has a cauliflower appearance. Cancer originating from the endocervix usually grows inward, but may grow outward as a papillary growth. Cancers originating from the endocervix are most dangerous, because they metastasize earlier to the parametrium; on the other hand cancers originating from the squamous epithelium of the cervix will metastasize earlier to the bladder and to the regional lymph glands.

## SYMPTOMS

The principal symptoms of cancer of the cervix in the order of their occurrence and importance are: leucorrhea, hemorrhage and pain. Leucorrhea is the first symptom of cancer of the cervix. I do not mean that more patients complain of leucorrhæ than any other symptom when first seen, for Schmitz states in his series that 61.5 per cent complained of hemorrhage; but if we could see these patients in the very beginning we would find a leucorrhea in most instances. Leucorrhea is a condition which should demand careful investigation. It is due to varied causes, and it is necessary to determine if possible the specific cause of every leucorrhea. We are prone to look upon leucorrhea too lightly. It is true that a certain amount of vaginal secretions is normal, but a definite leucorrhea is due to pathology, and we should try to determine the nature of the pathology, whether benign or malignant. Slight increase of vaginal discharges should make us suspicious of beginning carcinoma of the cervix. It is not intended to give the impression that all leucorrhæas are beginning carcinomas; in fact only a small percentage of leucorrhæas is due to carcinoma of the cervix, but cancer is a most serious condition and we cannot be over cautious in keeping in mind that leucorrhæas may be the beginning of carcinoma. Of the cardinal symptoms of carcinoma of the cervix, increased vaginal discharge is the first, and therefore the most important sign.

Hemorrhage is the symptom which causes most patients with carcinoma of the cervix to seek the services of a physician. Hemorrhage results from necrosis of the tumor mass and from trauma. The cauliflower variety bleeds more readily than those of the infiltrating type; therefore they are recognized earlier than those originating from the endocervix. Bleeding in the cauliflower variety is often profuse. Irregular bleeding, whether occurring as a menorrhagia or as a metorrhagia, and

whether slight or profuse should demand careful investigation.

Pain is a late symptom, and if we are to effect cures in these cases we must get them before they have reached the stage of pain. Pain is caused by metastasizes to the parametrium and to the regional lymph glands. These patients practically never complain of pain as long as the growth is confined to the cervix, so it is easy to realize when these patients have reached the stage of pain that they are practically all inoperable and that many of them are hopeless to any form of treatment.

## DIAGNOSIS

A positive diagnosis can be made only from a pathological examination, but it is a dangerous procedure to take a section from the cervix and not be prepared to institute immediate treatment. When a section is removed for diagnosis, the wound should be cauterized immediately with actual cautery. Whenever there is doubt as to the diagnosis a curettage should be performed or a section removed for pathological examination. In the examination of the cervix we should always make a direct inspection of it. A bimanual examination is also necessary in these cases.

## REPORT OF A CASE

The following case is reported because of its occurrence in a woman twenty years of age.

O. B. colored, aged twenty. (Date of birth March 4, 1907. She was born in the country and no birth record is available, but both parents assured me that the given date is correct), married, nullipara. Was first seen October 13, 1927. She gave the following history: About eight months previously she noticed a whitish vaginal discharge. There was a gradual increase of the discharge and it became slightly yellow. She first sought aid at a local clinic, about three months after noticing the leucorrhea. She was given a powder for a douche, but her condition did not improve and about a month later or four months after the appearance of the leucorrhea she began to flow more frequently than usual.



At first there was only a slight increase of irregularity, but the condition soon became worse until she was flowing two or three

far as it went it justified the probable diagnosis of malignancy. From the history, the appearance of the mass and from the pathological

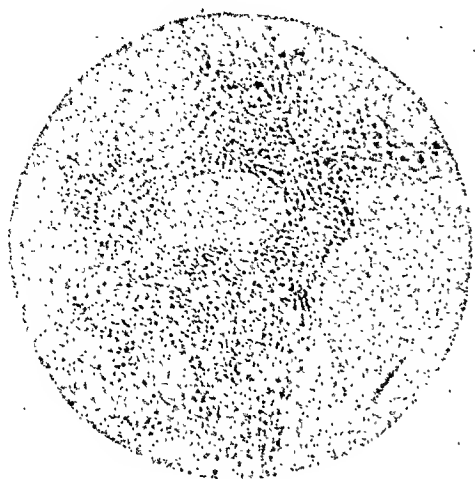


FIG. 1.

times each month. At that time she decided to call a private physician, which was about three months after the beginning of irregular and excessive flowing. He made a bimanual examination, but the examination was made at home and he did not use a speculum, the diagnosis not being determined. The bleeding continued to get worse and when she came to see me, she stated she had flowed every day for the past twenty days. When I first saw her it had been eight months since the leucorrhea began.

The following condition was found on examination: the cervix had a cauliflower appearance and it was about the size of a large English walnut. There was considerable raw surface and the bleeding was profuse. The mass was bleeding so freely that it was necessary to keep sponging almost constantly to get a good view. The mass was necrotic and two pieces of tissue, each of which was about an inch long,  $\frac{1}{2}$  in. and  $\frac{1}{8}$  in. thick came from it during sponging. The cervical canal could not be seen, but was felt anteriorly, the mass originating from the posterior lip. The fundus was slightly posterior, but was of normal size. There was no particular tenderness of the adnexa and there was no fixation of the uterus. The patient stated she had had very little pain. The sloughed tissue was examined by Dr. E. L. Straub, pathologist, Norfolk Protestant Hospital, who stated the tissue block was not adequate for the demonstration for all the pathological criteria of malignancy, but as

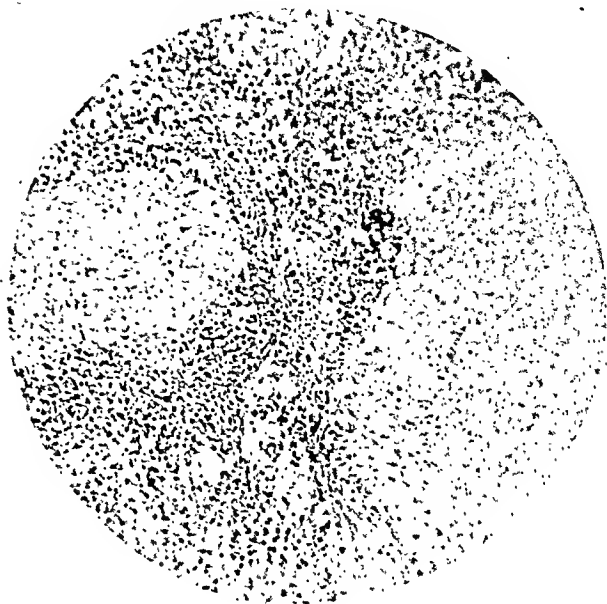


FIG. 2.

report it was felt certain that the condition was one of malignancy.

It was decided that this case would probably be more amenable to radium therapy than to any other form of treatment. (I wish to express my appreciation at this time to Drs. Gwathmey and Magruder for using their radium in this case.) On October 19, 1927 under gas-oxygen-ether anesthesia a section was taken from the mass before the application of radium was made. Four tubes of radium ( $12\frac{1}{2}$  mg. each) were inserted into the mass and they remained in situ for forty-eight hours. The section obtained from the mass demonstrated definitely the condition to be a squamous cell carcinoma of the cervix. The bleeding continued to show a gradual decrease, and there was a gradual decrease of the purulent discharge after the first week.

By December 10 or about seven weeks after the application of radium, the bleeding from the cervix had entirely ceased, and by January 5, 1928 there appeared to be practically complete epithelization of the cervix. During this period the cervix had gradually decreased in size, until it was only about 25 per cent larger than a normal cervix. At this time the patient was feeling considerably better; she had gained some weight; there were no masses in the adnexa or any evidence suggestive of metastases and we thought we had an excel-

lent chance for a cure. During the latter part of February however she began to have a purulent discharge and a few days later she

been unable to be out of bed since the last application of radium. The temperature was 102°F. and the pulse 104. The blood exam-



FIG. 3.

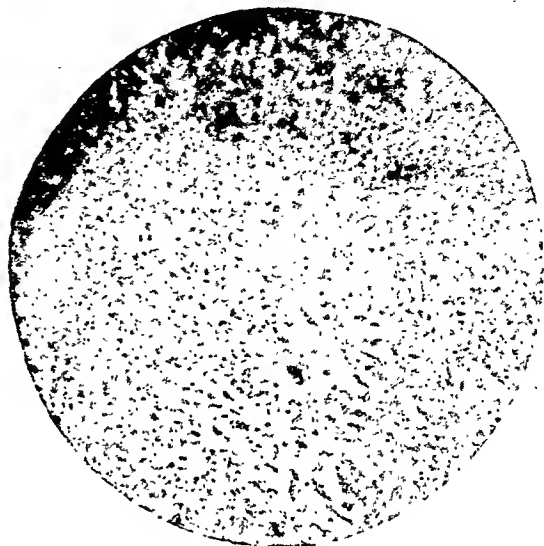


FIG. 4.

began to bleed. On inspection of the cervix it was found that the bleeding was coming from the posterior lip and from the cervical canal. At that time a small firm mass about the size of a small bird's egg had developed in the right adnexa. This mass had not been present on any previous examination.

On March 9, 1928, 50 mg. of radium were inserted into the cervical canal, remaining in place for twenty-four hours. The patient felt fairly comfortable until March 13, when she developed considerable pain in the right lower abdomen. There was considerable tenderness and rigidity in the right lower quadrant. The bleeding had ceased but there was a profuse purulent discharge. Fever developed, the pain and tenderness increased and the upper part of the right thigh began to swell. It was first thought that these symptoms might be the result of a thrombophlebitis. Although the patient's general condition appeared improved for a while, the mass in the right adnexa increased in size. There was practically very little pain in the right thigh. It then became more evident that the swelling of the thigh was due to involvement of the pelvic lymph glands, though part of the condition resulted from the infection.

On June 3, 1928 the patient was sent back to the hospital and it is to be noted she had

infection then was as follows: Right Blood Corpuscles 3,330,000. w.B.C. 22,400. Polymorphonuclears 79 per cent. Hb 60 per cent. Laparotomy was advised because it seemed evident there must be some pus present, but the patient refused operation. She continued to run a septic temperature and the pelvic mass grew more pronounced. She later consented to an operation and on June 11 a laparotomy was performed under ethylene anesthesia. There was an inflammatory mass involving the uterus, tubes, ovaries and a small part of the small intestine, which filled the right half of the pelvis and extended above the pelvic brim. Even though there was considerable pus present and most of the mass was evidently inflammatory, it was felt certain that part of the mass was due to metastasizes.

The swelling in the right lower abdomen and in the right groin increased until there was some fluctuation, and it was evident there was some free pus in that area. On August 16, 1928, 45 c.c. of a purulent and partly gelatinous substance was withdrawn from the area of fluctuation in the right lower abdomen. We continued to withdraw about 200 to 300 c.c. of fluid from this area twice weekly. It should be stated that long before this fluid accumulated the advisability of another laparotomy was discussed and it was thought inadvisable.

About the last of August an incision was made in the right lower abdominal wall just above the outer half of Poupart's ligament and the wound was drained. Both the abdominal wound and the incision in the abdominal wall continued to drain freely. The patient's condition was rapidly getting worse and she insisted on going home August 31, 1928. It should be stated that this patient had a four plus Wassermann reaction and that she received antiluetic treatment. The patient's condition continued to grow worse and she died September 28, 1928, which was less than one year from the time she was first seen. We were unable to get an autopsy, and even though this patient had a severe septic condition, we are confident there was marked metastasizes from the cervix. It is probably safe to assume that metastasizes had already occurred when this patient was first seen, even though no evidence of metastasizes could be made out. This case was so far advanced, that the outcome would have probably been the same regardless of the treatment. However, after having had more experience in the management of these cases, I believe the patient would have had a better chance if the greater part of the tumor mass had been destroyed by cauterization before the application of radium was made and if radium had been buried in the broad ligaments for the purpose of sealing off the lymphatics. The dosage of radium used should have been increased, so that the combined dosage in the cervix and broad ligaments would have been about 4000 mg. hours, and later deep roentgen-ray therapy employed. The regret in this case, however, is the fact the patient was not seen earlier.

#### TREATMENT

Report No. 40, Public Health and Medical Subjects, Ministry of Health, London, states that surgery gives slightly better results among the operative cases than radium. Lynch in his report concludes there is a chance of improving the total number of cures by operating radically in the early cases in which preoperative radium has been given and possibly postoperative deep roentgen-ray therapy has been employed, provided there is a limited operative mortality. Five-year end-results for radium or radium and roentgen-rays

for various clinics averaged 14.2 per cent. Five-year end-results for surgery in the Johns Hopkins series were 26.6 per cent; while five-year end-results for surgery in Graves' series were 18.5 per cent. Taylor and Peightal in their report on cancer of the cervix for the Roosevelt Hospital for 1924, state that radium or radium combined with x-radiation gave best results in advanced cases. Their five-year end-results from hysterectomy in early cases gave 25 per cent cures, while hysterectomy combined with radium in the early cases gave 31 per cent cures for five years. Operability decreases with advancing years and the end-results are slightly less favorable according to Report No. 40, Ministry of Health, London, which is contrary to most teachings that the younger the patient the less favorable the prognosis. Norris states there is a definite trend away from hysterectomy with its high mortality rate and frequent postoperative complications. He thinks the end-results are no better from hysterectomy than from irradiation. Norris gives his five-year end-results on all cases of cancer of the cervix treated with radium as 13.8 per cent; his early cases treated by cautery, amputation and irradiation gave 83 per cent cures; while his early cases treated by irradiation alone gave 28.5 per cent results. He attributes the better results in the group treated by amputation, cautery and irradiation, mainly to the fact that removal of the cervix gives a better and more accurate application of the radium. He states that in the Clark Clinic they have not submitted a case of cervical carcinoma to hysterectomy for five years. The importance of removal of the tumor mass by cauterization before the application of radium, and the importance of burying radium in the broad ligaments for the purpose of sealing off the lymphatics has been thoroughly stressed by Dr. Robert L. Payne, he also uses postoperative deep roentgen-ray therapy. Even though Dr. Payne prefers radium to any other method of treatment, he believes that the simple application of radium is often

inadequate and should be supplemented as stated here.

The following are some of the conclusions reached by the committee for the American College of Surgeons on the treatment of cancer of the cervix, with all cases having a minimum follow-up period of five years:

The successful cases were all treated with radium or by hysterectomy. No cures were obtained by other methods. The primary cases show 9 per cent and the recurrent cases show 8 per cent alive and well.

In the early favorable and borderline groups, hysterectomy alone gave successful results in 1 case in 5. Hysterectomy with radium, either before or after, gave better results than 1 in 4, but there was an operative mortality of 18 per cent in all cases of hysterectomy. Radium with or without cautery gave successful results in about 1 case in 6, but without operative mortality. The best results, 1 successful case out of 3, were obtained in cases in which both radium and cautery were employed.

In the treatment of recurrent cases after hysterectomy, and in cases of cancer of the cervical stump, the use of radium is to be preferred to other methods.

The value of radium as a palliative measure in advanced cases is beyond dispute. In the more advanced cases cures either by radiation or by hysterectomy were very few.

From the literature then it seems that practically all writers are agreed that radium or radium combined with cautery and deep roentgen-ray therapy is the proper treatment for borderline and advanced cases of cancer of the cervix. The treatment of the early cases of cancer of the cervix is still subject to controversy, but there can be no doubt about there being a trend away from hysterectomy even in the early cases. More and more radium is being used in the treatment of cancer of the cervix, and some authorities believe that radium combined with cautery and deep roentgen-ray therapy to be the only treatment for it.

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# The American Journal of Surgery

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## EDITORIALS

### X-RAY DIAGNOSIS OF BONE SARCOMA BY MAIL

ON September 14, 15 and 16th, 1930, a notable meeting was held at the Belvedere Hotel, Baltimore, Md. The meeting was organized by Dr. Joseph Colt Bloodgood under the auspices of the Surgical Pathological Laboratory of Johns Hopkins Hospital and the Chemical Foundation for the Study of Bone Tumors, recently established at Johns Hopkins Hospital by Mr. Francis P. Garvan. Dr. Bloodgood, in his introductory remarks, stated that invitations had been sent out to eight thousand radiologists by Mr. J. R. Bruce, Business Manager of the journal, *Radiology*. The American College of Surgeons, through the courtesy of Dr. Bowman C. Crowell, had sent invitations to all the standard hospitals in the country, and Mr. William V. Buffum, General Manager of The Chemical Foundation, had taken

charge of more than ten thousand invitations. Three-hundred and sixty men, mostly radiologists, registered for the meeting.

In his introductory remarks, Dr. Bloodgood said:

In these invitations we stated the object of this meeting is an attempt to bring before the profession in the form of post-graduate teaching the up to date information which will lead in practice to the earlier and more accurate roentgenological examination of bone diseases and bone tumors and the early and most advantageous forms of treatment. The records of more than 3000 cases of bone diseases and bone tumors which have accumulated in the Surgical Pathological Laboratory of the Johns Hopkins Hospital and University for the last forty years show that up to 1913 there was not a single verified case of sarcoma (cancer of bone), cured by any treatment. In 1921 when the number of cases was less than 500 there

were 4 per cent of cures by amputation only. Figures for 1930 show an increase to almost 30 per cent of patients who are living five years or more after treatment. The actual figures vary from 11 to 41 per cent in the different types of sarcoma. The cures have been accomplished chiefly by amputation, next by resection of the bone involved, and third by irradiation with x-ray or radium.

There is only one explanation of this tremendous and startling improvement in cures and that is the people have been educated through the press on the importance of immediate x-ray examination whenever there is any symptom of pain or swelling in the region of a bone or a joint, whether there has been an injury or not. The people have been educated to disagree with their doctor if they make a diagnosis of rheumatism, neuritis, bruise, sprain, Charley horse, growing pains, without an x-ray examination. It is perfectly possible for the press to get this knowledge to every individual in the civilized world.

The program consisted of specially prepared papers or addresses on different types of bone tumors and conditions simulating neoplasms of the bones. There were six such papers on Monday, three on Tuesday and three on Wednesday. Between the reading of these special papers was carried on the original part of the program, that is, throwing upon the screen simultaneously, four slides illustrating: (1) the roentgenological appearance of the bone before amputation or other treatment, (2) the specimen after amputation, (3) the histological appearance of the tumor. A brief clinical history was given and then every one in the audience was asked to write upon a card his own diagnosis. The cards were collected and the results announced. Sixty such cases were presented during the three days. While a large number of men made a correct diagnosis, in some cases men of the largest experience in the study of x-ray diagnosis of bone tumors, failed. This could only be expected inasmuch as the diagnosis of bone from the roentgenogram alone is often extremely difficult.

Dr. Bloodgood deserves great credit for

having organized such a meeting which entailed a vast amount of work. There is no doubt that it did a great deal of good and that most of the men came away from it with a greater knowledge of how to diagnose and how to treat a case of bone sarcoma. It is hoped that they also learned more about the difficulties associated with the diagnosis of these tumors. The reports of the meeting in the daily press, unfortunately, we believe, laid greater stress upon the ease and certainty of diagnosis than upon the difficulties and often uncertainties. Under a news item entitled "Remote Patient May Have Care of Specialists,"\* we find the following:

The recent great steps forward in radiology, especially as a means of diagnosis, it was pointed out, have contributed the additional virtue of enabling specialists in distant cities to accurately determine the condition of bed-ridden patients in small towns, who could not possibly be transported to a clinic.

Photographs taken by x-rays may now be mailed by special delivery to a specialist and the trouble diagnosed and a treatment prescribed with just as much accuracy as if the specialist were to visit the patient or the patient were brought to the clinic.

We believe a great deal of harm will be caused by creating the impression that the diagnosis of bone sarcoma, especially in the early stages when it must be made in order to give a reasonable chance of cure, is so easy that all we have to do is to send a roentgenogram of the bone to an expert radiologist and get back a positive diagnosis by return mail. Nothing could be further from the truth nor from fact than that it is possible to make a correct diagnosis of a bone sarcoma from the roentgenogram alone in all cases. There are many cases, in the early stages of the disease, in which it is impossible to make a diagnosis from the roentgenogram even when supplemented by the clinical history. In these cases to make a correct diagnosis the following is required: a careful physical examination by a surgeon of large experi-

\*N. Y. Herald-Tribune, Sept. 21, 1930.

ence in dealing with bone tumors. He must get a careful history of the case with especial reference to antecedent local trauma. He must study the location of the tumor, its consistence, the color and texture of the overlying skin, and the presence of local or general temperature. In addition in a very considerable number of cases a biopsy will be necessary before one can make a correct diagnosis. The biopsy should be performed by the man who is ultimately to have charge of the treatment. He must be familiar with both the macroscopical appearance of the tumor and the histological structure of the

different varieties of bone tumors and inflammatory lesions of bone. In addition, he will naturally have had a large experience in the interpretation of roentgenograms of bone tumors. The surgeon must be able to correlate all these different and valuable aids to diagnosis, and must weigh the evidence carefully before he can advise the best method of treatment. In short, it requires the cooperation of the surgeon, the pathologist and the roentgenologist to make a correct diagnosis of bone sarcoma especially in the early stages of the disease.

WILLIAM B. COLEY.



## THE LOCALIZATION AND EXTRACTION OF FOREIGN BODIES

THERE are some extremely simple and easily accomplished methods for the localization and extraction of foreign bodies. The basic principles are as old as mathematics and were applied in radiology within three months of Roentgen's first publication. Buguet and Gascard had the distinction of the first published application of triangulation to the radiological estimation of the position and depth of an opaque foreign substance in the human body. Sir James Mackenzie-Davidson devised the crossed thread method of visualizing and simplifying the triangulation method which found such wide use during the World War. The "nearest point" method, the "harpoon" method, the "parallax" method, the method of "rotation of the part through ninety degrees," and numerous other devices were popularized by the millions of opportunities offered during the great conflict. Especially in the French and German armies removal of projectiles and other foreign bodies under fluoroscopic control was the favorite method of extraction where the surgeon found difficulty in locating the offending substance with the aid of the marks put on the part by the radiologist during the fluoroscopic locali-

zation. In the United States army these methods were widely taught but our participation in the conflict was not of long enough duration to allow the development of anything like an established method or technic. It was not at all generally realized, except by the American physicians who actually served in the forward battle area, that foreign body localization could be satisfactorily performed by the aid of the fluoroscope, without any radiographic assistance, in all but a very small proportion of cases, or that radiologic aid when needed during the extraction of such projectiles was immediately available by the use of the fluoroscope, either in the x-ray department or by portable x-ray apparatus and bonnet fluoroscopes used in the operating room.

Because of the relatively short apprenticeship of most American physicians in war surgery and the considerable lapse of time since the close of hostilities, it seems to be a fact that in the average hospital in the United States the fluoroscope is not being sufficiently or properly used as an aid in finding and removing such foreign bodies as are encountered in peace times. Instead of rapid, economical fluoroscopic localization, there is a rever-



sion to the older and more expensive method of stereoscopic films or films in two directions. And for the extraction of the offending particles one seldom sees use made of fluoroscopic aid. As a matter of national preparedness against military contingencies, as well as in the interests of economy of time and materials, one should urge the more general adoption of the war proved methods of fluoroscopic aid in the operating room.

The removal of superficially lodged needles, nails and other foreign bodies commonly encountered in civil life is often seen as a tedious, long drawn out operation trying the patience of both surgeon and patient because x-ray films are made and posted in the operating room, and in good light a persistent effort is made to seize what appears to be an easily accessible solid substance; whereas under fluoroscopic guidance it is usually possible to remove the offender promptly, with a minimum of traumatism through dissection of soft tissues.

For the more deeply lodged projectiles or other foreign bodies it is possible to improvise an operating set up in the x-ray department, but it seems more logical to set up a portable x-ray equipment in the surgical operating room where the surgeon

can work under good light and with every facility at hand for emergencies, with the radiologist lending his aid through the help of a fluoroscopic bonnett, such as the Dessane bonnett with which many of us became familiar during the war.

Nor is this method of x-ray assistance to the surgeon confined to foreign body surgery; it is also applicable to the localization of pulmonary abscess and for guidance of the surgeon to the abscess during operative intervention. Sometimes a mechanical device like the Hirtz compass may be used to advantage, for it may be sterilized and taken into the operation for use as often as the surgeon needs. In operations for renal calculi it is sometimes needful to employ the fluoroscope at the table side to guide the surgeon. The United States Army X-Ray Manual prepared under the supervision of the Surgeon General's office during the World War, the Surgeon General's History of the World War, and various surgical monographs and systems contain descriptions of the methods already referred to, but it has seemed to the writer that it is profitable and opportune to call attention to the somewhat neglected field for their use in civil practice.

JAMES T. CASE.



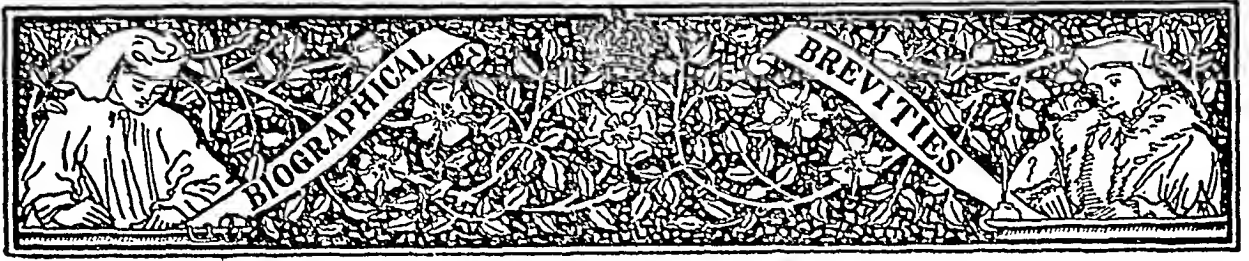
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GIOVANNI BATTISTA MORGAGNI

[1682-1771]



## “FORAMEN OF MORGAGNI”

**J**OHANNUS . BAPTISTA MORGAGNUS “introduced the anatomical idea into medical practice” according to Virchow. His countrymen called him Giovanni. In English he is known as John Baptist.

Morgagni was born in the town of Forli, Italy, on February 25, 1682. There he received his early education. He was a genius and because of his knowledge of literature he was elected to the academy at the very immature age of fourteen years.

He graduated and received the degree of Doctor of Medicine at Bologna in 1701. Even in those days to be a full-fledged doctor of medicine at nineteen was enough to make one stand out from the crowd. He became a Demonstrator of Anatomy at his Alma Mater. His predecessor was Valsalva. Later, he occupied the chair of the Theory of Medicine and the chair of Anatomy at Padua. His reasons for going to Padua were unique. At Forli he gave up teaching to engage in private practice. At this he was successful. Being successful he found little or no time for research. This made him dissatisfied with his lot. So, in 1712, he bade Forli farewell and

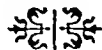
accepted the professorship at Padua, which position he held for sixty years.

Morgagni is known to students of the history of medicine for two great works. His “*Adversaria Anatomica*” was sufficient to have made any man famous. In addition he produced his great “*De Sedibus et Causis Morborum per Anatomicum Indigatis*.” This is comprised of a set of letters, seventy in number, making five volumes. He was in his seventy-ninth year when he undertook this gigantic task. In letter 54 he wrote on “Hernia through the foramen of Morgagni,” from which medical students know the eponym giving us the title of this sketch.

Many anatomical terms are associated with Morgagni’s name. We list: Morgagni’s appendix, crypts, frenum, humor, tubercle, column, glands, cysts, valve, fossa, sinus and ventricle. This list is far from complete.

Walsh has referred to Morgagni as the Father of Pathology.

A teacher for nearly seven decades, the author of two works that have lived for two centuries and will live until the twilight of time, Morgagni lived to be a very old man, keeping his faculties until the end, which occurred in his ninetieth year, on December 6, 1771.





[From Fernelius' *Universa Medicina*, Geneva, 1679.]

# BOOKSHELF BROWSING

STUDIES IN PALEOPATHOLOGY, XXVII

## A SUGGESTION OF RICKETS IN THE PLEISTOCENE

ROY L. MOODIE, PH.D.

SANTA MONICA, CALIF.

COMMENTS on the early evidences of rickets in ancient times reveal the fact that the disease is utterly unknown among the thousands of fossil vertebrates which have been studied by a great number of scholars. It is well known, however, that this disease occurs among many recent and especially among the domesticated mammals and birds. P. C. Schmerling has suggested this disease as the explanation of the appearance of certain bones of a Pleistocene bear found in Belgium and Poncet has described and figured a set of limb bones representing an ape, mummified, from early Egypt, which are undoubted examples of rickets. F. Wood Jones and G. Elliot Smith in their extended, prolonged search for rickets among the early Nubians and ancient Egyptians found not one of the cardinal signs of the bony manifestations of rickets. Extensive search, by roentgenograms of a large series of pre-Columbian mummies from Peru, has yielded no single case of rachitic deformation, although numerous children were examined, nor has there been a definite example of this disease seen in the osteological collections of ancient races.

This dearth of definite evidences of the presence of rickets in ancient times has

caused me to hesitate a long time over the presentation of the evidence, in the giant Pleistocene wolf, (*Aenocyon dirus*) of the Rancho la Brea, of what seems to be a rachitic bone represented by a left, adult femur.

The bone is shown in the middle figure and it presents a uniform, definite arc which involves the entire length of the bone. It is quite possible that this isolated bone is an extreme variant of the curvature seen in other wolf femora, as shown in the figure. Most of the wolf femora present a slight curvature, but this is usually restricted to one part of the shaft. Many femora are straight.

This wolf femur has a length of 223 mm., as compared to a length of 250 mm., for the bone shown on the left, and 240 mm., for the one on the right. There are, however, many wolf femora, apparently adult, which measure less than 223 mm. The maximum is about 270 mm. It is thus clear that the rachitic (?) femur is in the lower range of dimensions. This suggests nutritional disturbances.

The femur in question is badly pit-worn. "Pit-wear" is due to a prolonged rubbing of bone on bone through centuries of shift-

ings in the viscid material by great gas bubbles pushing their way up the "chimney." For some time I thought the extreme

The limb bone of a small hawk, from the Rancho la Brea, shows similar manifestations of rickets, so it may be that this

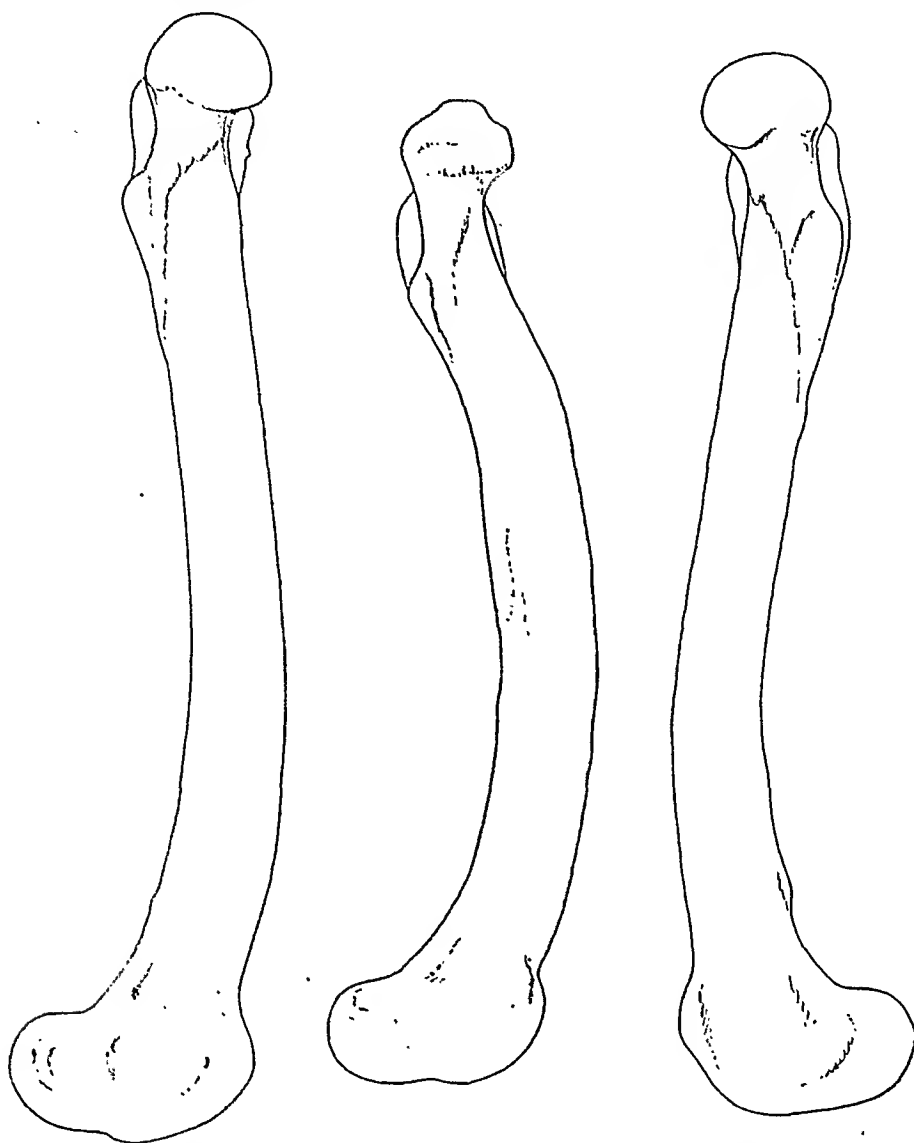


FIG. 1. Three Pleistocene wolf femora, Rancho la Brea.

*Left:* Left wolf femur, measuring 250 mm. in length with angle of torsion of  $10^{\circ}$ , showing a moderate degree of curvature, largely restricted to lower half of bone.

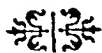
*Middle:* The rachitic (?) bone, a left femur of Pleistocene wolf, measuring 223 mm. in length and presenting definite diaphyseal curvature involving entire bone.

*Right:* A right, adult, wolf femur, 240 mm. in length, showing slight curvature of lower one-half.

(All specimens in the Los Angeles Museum.)

curvature might have been due to pressure of overlying bones, but there is nothing to indicate that this really happened.

disease actually did occur in the Pleistocene, though the evidences so far seen are not entirely satisfactory.



## BOOK REVIEWS

ENCYCLOPAEDIA BRITANNICA. Ed. by James L. Garvin. Am. Ed. Franklin H. Hooper. Ed. 14, N. Y., Encyclopaedia Britannica, Inc., 1929.

At a recent meeting of the American Philosophic Society Abraham Flexner, former Secretary of the General Education Board, likened the American University to a modern drug store where a little bit of everything, including drugs, might be had. The Britannica, it seems to the reviewer, is a University in Print. Similarly, it has its contemporaries and its competitors, its adherents and its adversaries.

The analogy to a drug store or modern department store is perfect. You can indeed "find a little of everything, including drugs" in the Britannica. There is a remarkably complete supply of everything that the twentieth century citizen is apt to want and in truly modern fashion "self service" is simplified by a splendid inventory of stock, an Index comprising half a million headings, an achievement that few, if any, other organizations can duplicate.

But it is to the institution of learning that the Britannica bears most resemblance. And it is along these lines that our thoughts choose to run. We will attack our problem as we would undertake a survey of a large university. And so, we will have a look at the faculty.

Some years ago in a talk at Lennox, Mass., Roger Babson surprised an audience of several hundred men (mostly college graduates) by asking the question "who is the editor of the Encyclopaedia Britannica?" Only one man knew it! The speaker elaborated on the text, "The futility of learning as a means to fame and popularity." Every man in the audience knew all about Babe Ruth and Al. Capone and their invaluable contributions to the intellectual development of the Universe, but of the Editor of the Britannica they knew nothing. The twenty-five page "editorial preface" to the Britannica is a document quite comparable to the best inaugural address of any college president. James Louis Garvin is the editor of the 14th edition, and a better would be hard to find. The college president of today is said to be mainly an executive and a money getter. Our editor is certainly an executive but is free from the necessity of raising money. Therefore, his energies are in no way scattered and the

influence of his genius is concentrated on the work itself.

The Preface covers the history of the various editions of the Britannica and gives the rationale of encyclopaedia-making in common sense fashion. A few of the "dry facts" included are illuminating and will bear repetition, especially as they have a distinct bearing on some of the comments to be made later. For instance, we discover that the twenty-four volumes "contain thirty-five million words, the equivalent of *five hundred* ordinary octavo books." And it is pointed out that a separate encyclopaedia for any one of its many departments might run into as many volumes without containing one dead word. This point must not be overlooked when criticism is attempted. A further fact that anticipates and defeats possible criticism is the necessity for the timely completion of a work of this kind. "It must be finished, however imperfect it may be." Be it also remembered," says the editor, "the larger the number of volumes the easier is the task of the editorial staffs and contributors." Many devoted contributors cry humanly . . . "you are cutting away my flesh and blood." But he points out not even one hundred volumes would allow for a complete covering of even *nearly* every subject.

This edition was entirely rewritten and reset within the period of three years! Terrible though it may seem that the famous 11th edition of twenty years ago should already go into the discard, Mr. Garvin makes an unanswerable argument for the necessity of this. "Into less than a decade was crowded, as never before, tumult and revolution enough for an average century or more." How true, and how far reaching! Changes that began with politics have radiated into almost every department of human affairs. In 1910 the radio was still wireless telegraphy, broadcasting was unknown, x-rays were still largely employed for bone examinations only, Einstein was not even mentioned in the index, our ideas of space and time were still the old fashioned ones that everyone could at least pretend to comprehend, hormones were not indexed and the quantum theory was unheard of. There was no separate contribution on the aeroplane. Lindbergh was still in his swaddling clothes. Insulin had not been discovered. The chain store idea was still in its infancy. In short, practically every phase of human endeavor



or has been revolutionized in the past twenty years, presenting to the encyclopaedia maker a task the like of which probably has no precedent. It is the result of three year's concentration on, and devotion to, this task that is now before us for consideration.

Looking upon the Britannica as an institution, it may not be amiss to consider the fact that Editor Garvin and his contributors probably exercise a larger educational influence than the faculty of any one college or even many of them put together. Not only is the Britannica the stimulus for many of those denied a so-called college education, but probably most college graduates supplement their fund of information by continual reference to it. The attempt to evaluate an educational force of such magnitude is not one to be lightly undertaken.

Naturally, the readers of this Journal are most interested in Medicine and Surgery. We find the following names composing the Departmental Editors and Advisory Board: Edward N. da C. Andrade, Joseph Barcroft, Julian Huxley, Abraham Wolf, John Dewey, Raymond Pearl, James Harvey Robinson, David E. Smith, W. S. Lazarus-Barlow. Surely these are names to conjure with. As was to be expected from such a board they have secured for the writing of each article authors of the highest standing and authority. To list all the collaborators would be to compile a "Who's Who in Medicine and Surgery." The subjects treated also would call for the equivalent of a condensed Medical Dictionary, so that only the high spots can be touched even in what may seem to be a lengthy consideration of the subject.

As an illustration of how the subjects of most interest to us are treated let us turn to the word, "Medical." We find the following *large type* sideheads: Medical and Surgical Societies; Medical Articles (and here we find smaller sideheads as follows: Anatomical, Bacteriological, Pharmacological, Midwifery and Diseases of Women, Surgery, Medicine, Public Health, Tropical Medicine, Veterinary Medicine and Miscellaneous), Medical Education, Medical Jurisprudence, Medical Legislation, Medical Research, (again with many small sub-divisions) Medical Service, Army and Navy.

The following are a few of the articles and authors under the sub-division Medicine: Medicine (History of), Charles Singer; Medi-

cine (General), Sir Humphry D. Rolleston; Medical Education, Nathan P. Colwell; Medical Legislation, Robert Scott, J. W. Holloway, Jr., etc.; Medical Jurisprudence, Ernest E. Smith; Medical Research, Walter S. L. Barlow; Alimentary System, Robert Hutchison; Anaemia, Andrew C. Ivy; Children (Diseases of), George F. Still; Diabetes, C. H. Best; Diagnosis, Sir Humphry D. Rolleston; Encephalitis Lethargica, Henry L. Tidy; Epilepsy, William T. Shanahan; Heart, Frederick G. Parsons, James E. H. Roberts, and others; Influenza, Stevenson L. Cummings; Insanity, C. Stanford Read; Paralysis, Sir Frederick W. Mott; Paranoia, John Macpherson; Paratyphoid, Noel T. Whitehead; Psychosis, Henry Devine and C. S. Read; Respiratory System, F. G. Parsons; Rheumatism, P. Lazarus-Barlow; Skin Diseases, J. M. H. MacLeod; Tuberculosis, Allen K. Krause; Typhoid Fever, Noel T. Whitehead.

Under "General Medicine" Sir Humphry Rolleston in three and a half pages gives a concise survey of Modern medical practice, a splendid conversational discourse in plain language that might well be taken as a model for presenting the case for modern medicine to an intelligent lay audience.

The History of Medicine as discussed in nine pages by Charles Singer is a model of the art of presenting information in condensed form. If it would be easier to edit a Britannica in 100 volumes than in 24, then by the same token it is easier to write even the outline of the History of Medicine in 100 pages than in 9. These few pages, however, are interspersed with references to other articles; mention of subjects like Biology, Neurology, Surgery and persons like Hughlings Jackson, Chareot, Virehow and innumerable others being followed by those ubiquitous friends of the Encyclopaedist, the initials Q.V. The two articles mentioned are ideal for orienting the average medical man along the lines of cultural medical thinking. Not intended to help him out in problems of active practice, they will furnish just the material needed for discussions with patients and for discourses before lay audiences. In fact, the average patient with his faculty for asking embarrassing questions may well be referred to the Britannica for information.

This splendid array of articles on Medicine and Surgery represents only a small portion of the literary pabulum offered in this work.

Just as the layman will get medical thought in understandable form from these pages, so will the physician himself (a layman on so many subjects) get just what he needs along other lines. In fact, a whole course, on any subject is available in these volumes. The high spots are well treated and the bibliographies are such that further reference is made easy.

The Britannica is in reality a "mirror of universal knowledge," and as an index to the culture and literature of the world, will be found worthwhile in every home and office.

**BURNS.** By George T. Pack, M.D., and A. Hobson Davis, M.D. 370 pp., 60 illus., Phila., Lippincott, 1930.

An interesting and thorough discussion of burns based, as the authors state, not only on "personal experiences but also a free analysis of the contributions and opinions of other clinicians and investigators." For practical purposes this book is perhaps too detailed and elaborate but for reference it should be found invaluable.

**CHRONIC NASAL SINUSITIS AND ITS RELATION TO GENERAL MEDICINE.** By Patrick Watson-Williams, 238 pp., 109 illus., New York, William Wood & Co., 1930.

A splendid and complete monograph covering a subject of increasing importance. While the subject is primarily of interest to the nose and throat specialist, this volume should do much to give the general surgeon the information on this subject which he requires. Splendidly illustrated and well indexed, the volume will be found an excellent work of reference.

**CONGENITAL CLUB-FOOT.** By E. P. Brockman, M.CHIR., F.R.C.S. 20 pp., 92 illus., New York, William Wood, 1930.

"The work upon which this monograph is based was carried out in the Orthopaedic Department of St. Thomas's Hospital, London, whilst the author was working there as Chief Assistant. It was awarded The Robert Jones Gold Medal for 1928, given by The British Orthopaedic Association."

As might be expected from a prize-winning monograph, the subject is completely covered and the illustrations are splendid. It is unfortunate that there is no index.

**ULTRAVIOLET RADIATIONS AND THEIR USES.** By Robert Aitken, M.D., F.R.C.P.E. With a Foreword by Sir Norman Walker. 200 pp., 15 illus. Edinburgh, Oliver and Boyd, 1930.

The author presents in 200 pages the experience of seventeen years in ultraviolet radiation therapy. He has had a long experience in treatment by radiation and other methods of many conditions in which the use of radiation has been urged by some writers "whose enthusiasm outruns judgment." Ultraviolet therapy has been recommended for many diseases which it offers very little likelihood of help, as for instance in the treatment of scabies. The author's chief aim in this book evidently has been to adhere strictly to the practical benefits of light therapy. The final chapter includes a very interesting discussion of radiation in dentistry and commerce. The abuses of radiations are treated all too briefly, considering the rather extravagant claims which have been made. Many writers have said that ultraviolet radiation is beneficial in most skin lesions, some going so far as to remark that radiations are useful in the treatment of skin diseases from A to Z (aene to zoster). Dermatologists do not make this claim. Numerous photographs illustrate the value of the author's teaching. Many practical hints are described to facilitate the application of ultraviolet radiation in various diseases.

**DIE CHIRURGIE.** Pt. 27. Eine zusammenfassende Darstellung der allgemeinen und der speziellen Chirurgie. By Prof. Dr. M. Kirschner and Prof. Dr. O. Nordmann. 223 pp., 170 illus., Berlin, Urban & Schwarzenberg, 1930.

The twenty-seventh part of "Die Chirurgie," edited by Prof. Dr. Kirschner and Prof. Dr. Nordmann, contains over two hundred pages devoted to surgery of the spinal cord by Heymann. Like the other parts of this System of Surgery, it is well written, well illustrated and up-to-date. With the completion of the work, German-reading surgeons will have at their disposal an incomparable series of monographs on the surgery of today.



A CLINICAL STUDY OF THE  
ABDOMINAL CAVITY AND PERITONEUM

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PUBLISHED SERIALY IN

*The American Journal of Surgery*

TENTH INSTALLMENT

SECTION II. THE GASTROINTESTINAL TRACT (CONTINUED)

[In the following pages the Journal page number will be found at the bottom of the page.]

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# A CLINICAL STUDY OF THE ABDOMINAL CAVITY AND PERITONEUM\*

## SECTION II. THE GASTROINTESTINAL TRACT (*Continued*)

### C. THE ABDOMINAL VASCULAR SYSTEM

The vascular system will be reviewed under the following headings:

1. Relations of Veins and Arteries to Abdominal Diagnosis.
2. Surgical Management of Abdominal Vessels.
3. Rôle of Blood Vessels in Determining Anatomical Arrangements within the Abdomen.

Lymph vessels and lymph nodes will be separately considered.

I. RELATION OF VEINS AND ARTERIES TO ABDOMINAL DIAGNOSIS. Veins furnish many significant leads with regard to intra-abdominal disorders. Clinical evidences they afford are to be seen upon simple inspection at the first examination of the patient and are, therefore, of particular value. Veins appear of even greater diagnostic importance than arteries, for many are superficial in location and the low degree of normal venous pressure renders them readily subject to blockage and visible stasis. Dilated vessels by their locations at once suggest probable sites of obstructing lesions. A disorder deep within the abdomen may be betrayed by a single dilated superficial vein.

Partial blockage of the external iliac vein is followed by edema of the isolateral extremity and by stasis within venous tributaries situated upon the upper thigh and the lower part of the anterior abdominal wall (Fig. 154A). The effects of such an obstruction, and of similar obstructions involving other vessels which carry blood to the heart by way of the inferior vena cava, are illustrated in accompanying diagrams (Fig.

External Iliac Vein  
Obstruction

\* Previous installments of this book appeared as follows: Vol. viii: January issue, p. 193; February issue, p. 459; March issue, p. 693; April issue, p. 911; May issue, p. 1109; June issue, p. 1325; Vol. ix: July issue, p. 157; August issue, p. 365, September issue, p. 581.

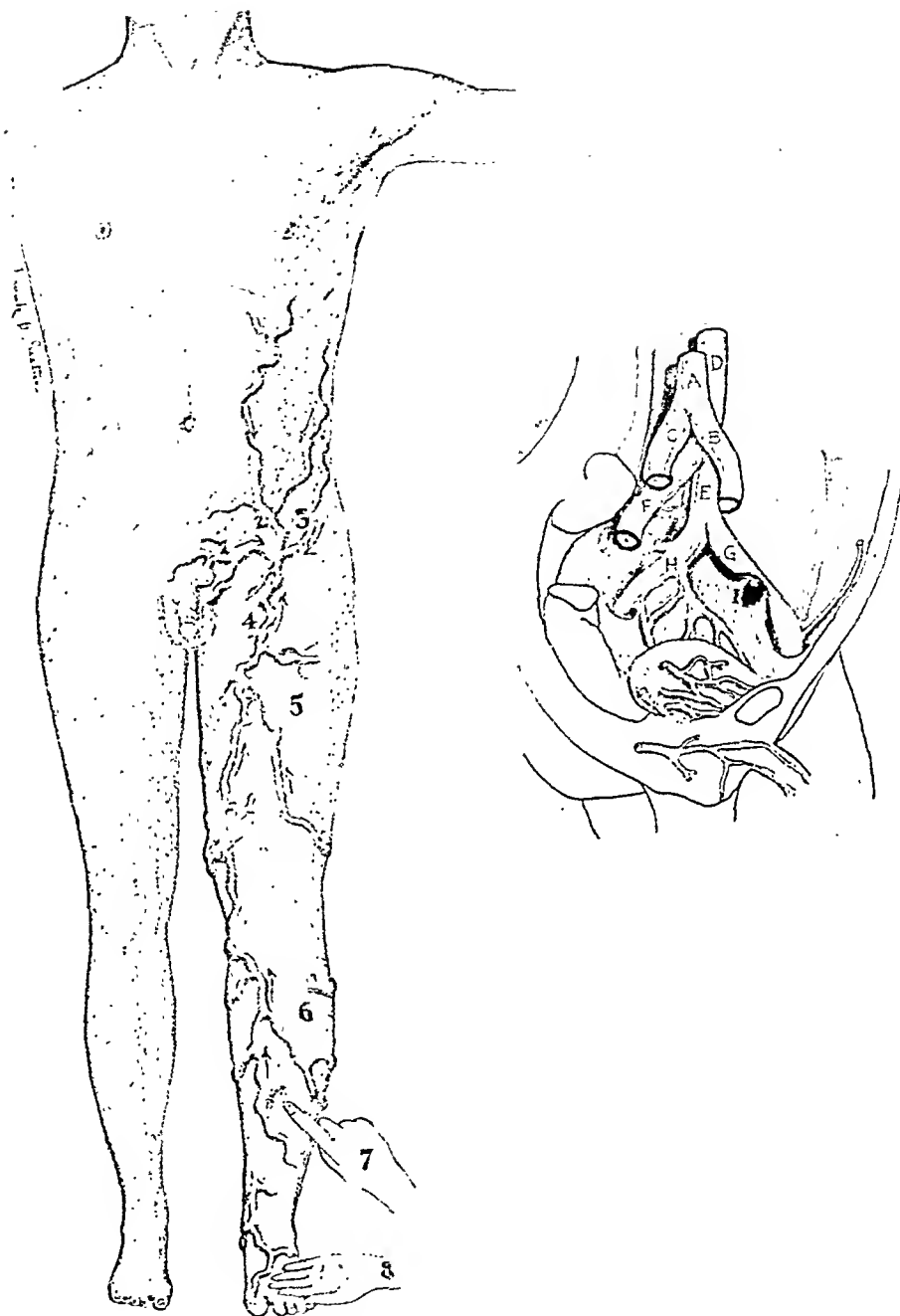


FIG. 154. A. Obstruction to external iliac vein.

1. Superficial pudendal vein.
2. Superficial epigastric vein.
3. Superficial circumflex iliac vein.
4. Long or external saphenous vein.
5. Pallor.
6. Purpuric discolorations.
7. Pitting.
8. Diminished external heat.

(Arrows show direction of blood current.)

Insert demonstrates a malignant nodule (i) obstructing the external iliac vein (G).

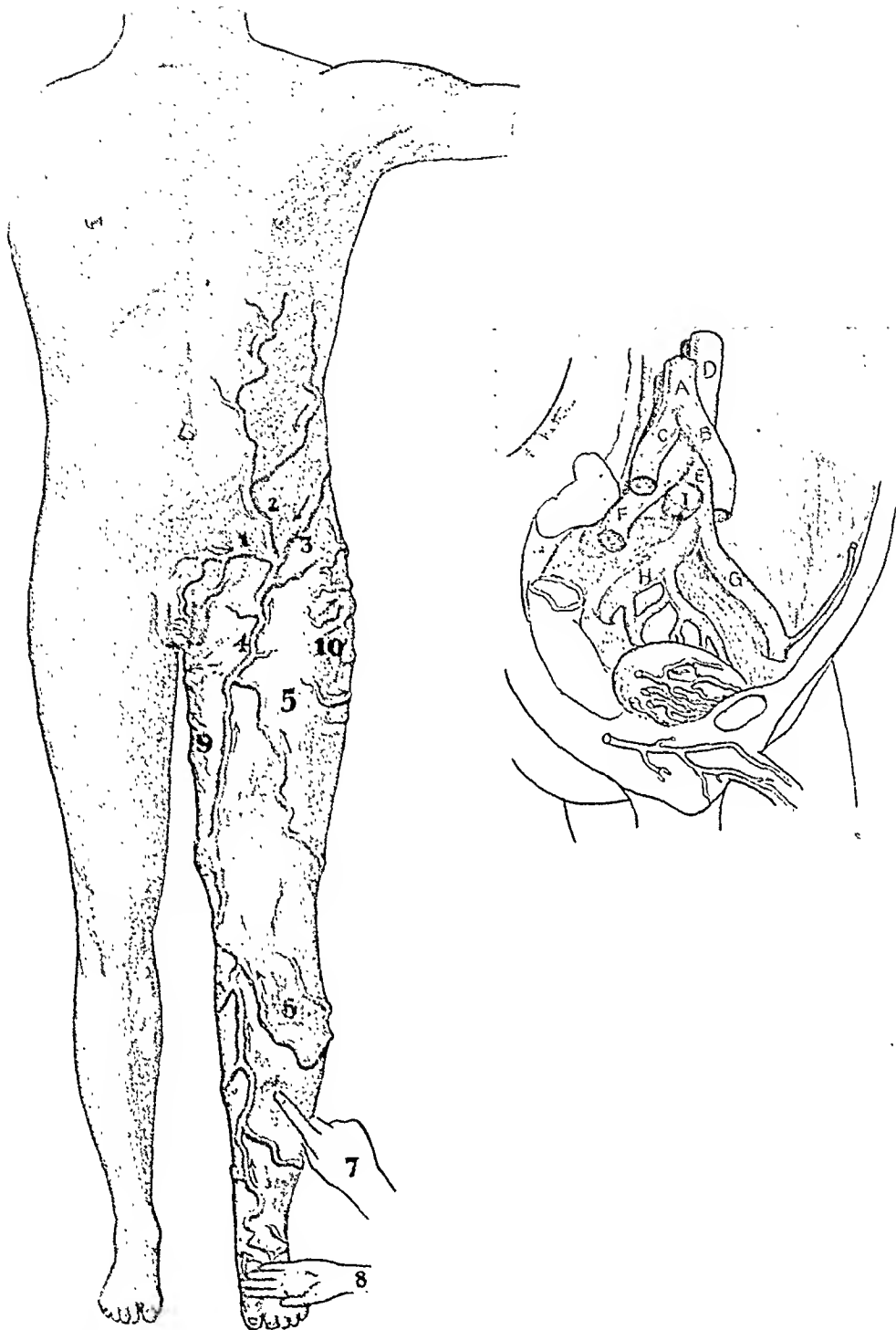


FIG. 154. B. Obstruction to common iliac vein.

The malignant nodule (I) presses against the common iliac vein (E) yielding stasis within the hypogastric vein as well as within the external iliac vein.

Note venous dilatations upon the inner (9) and outer (10) sides of the upper portion of the thigh.



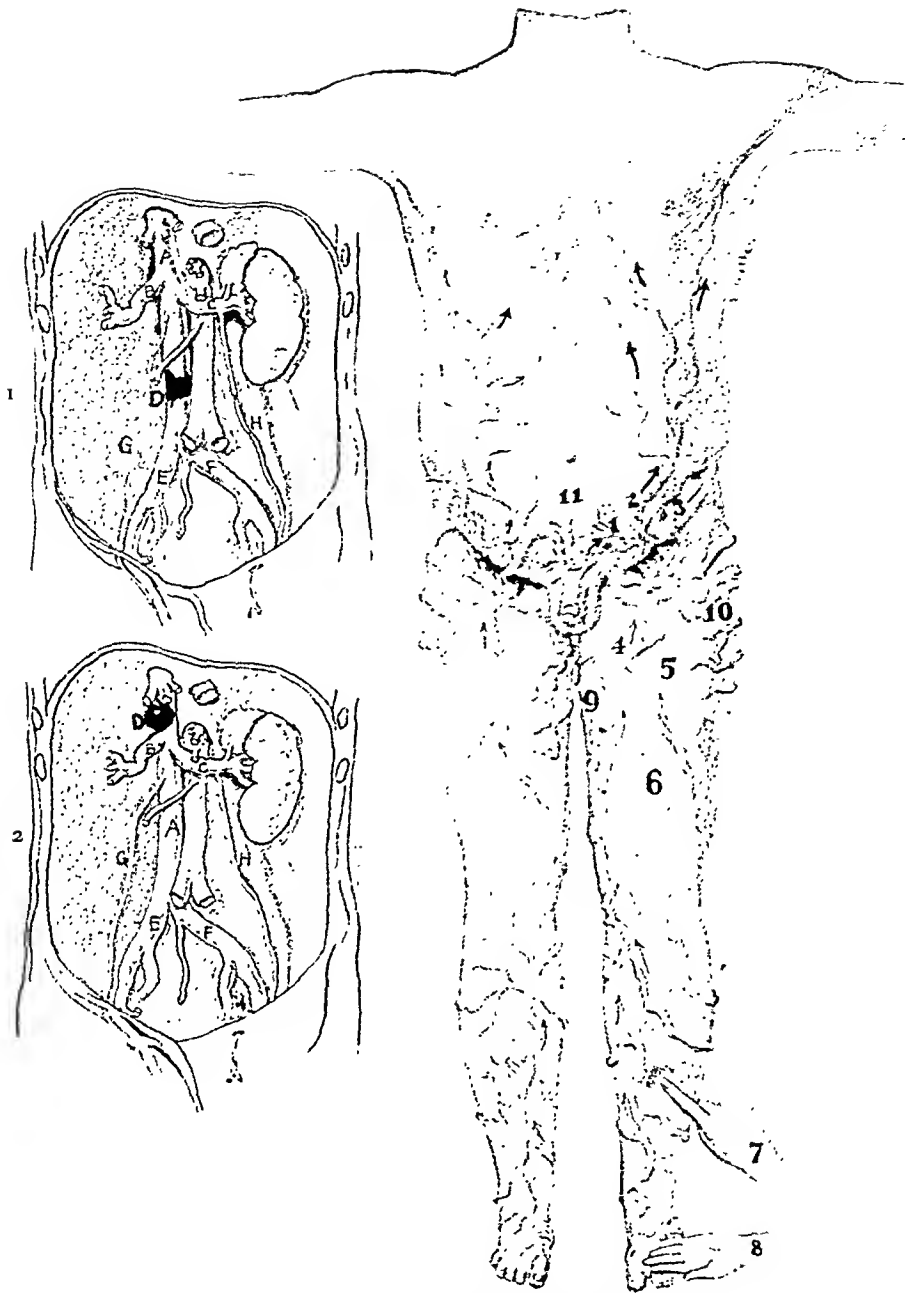


FIG. 154. C. Obstruction to the inferior vena cava.

Insert 1 shows thrombosis (D) within inferior vena cava producing the venous dilations shown in the figure.

Insert 2 shows obstruction of cava above level of the renal vein (D) adding a typical urinary picture.

1. Superficial pudendal vein.
2. Superficial epigastric vein. Note reversal of venous current which now travels upward to axilla and thorax.
3. Superficial circumflex iliac vein.
4. Long or external saphenous vein.
5. Pallor.
6. Purpuric discolorations along veins.
7. Pitting on pressure.
8. Diminished heat.
9. Obturator and internal pudendal veins.
10. Inferior and superior gluteal veins.
11. Note relative freedom from varices about umbilicus; also note presence of ascites.

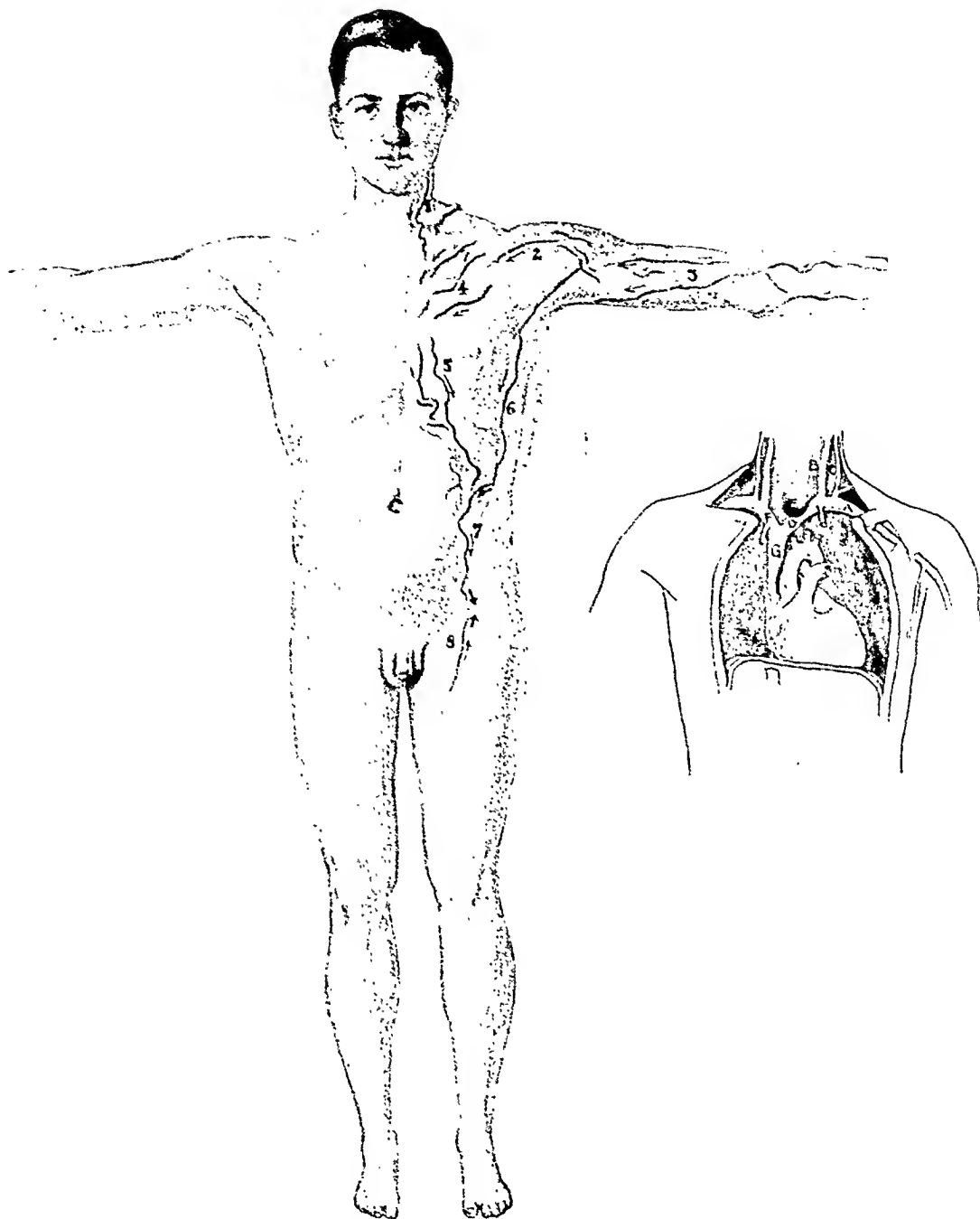


FIG. 154. D. Mediastinal obstruction.

Insert shows malignant nodule (E) pressing on left innominate vein (D). Note that collateral circulation is most marked over thorax; also that veins of neck and arm are engorged. Only one of uppermost tributaries of long saphenous vein is involved. Observe direction of venous currents.

1. External jugular vein.
2. Cephalic vein.
3. Basilic vein.
- 4, 5. Superficial veins of anterior thoracic wall.
6. Lateral or long thoracic vein.
7. Superficial epigastric vein.
8. Long saphenous vein.

154A-D). With iliac vein obstruction the involved lower extremity appears swollen and is found to pit upon pressure. The skin is smooth and glossy. The leg and foot are pale, due to obliteration of superficial arterioles. And because of the fluid which has transuded into the free tissue spaces, producing an insulating effect, the parts seem cool as compared to their anatomical mates. The edema is greatest in the front of the leg, but in the back of the thigh.<sup>206</sup> For the degree of back-pressure within the short saphenous trunk is reduced through resistance afforded by tissues which surround and support the femoral and popliteal veins; while the long saphenous vein (Gr. *sapheinous*, visible) remains both superficial and unsupported throughout its entire course, thereby favoring a more marked edema with an increase in pitting about the front of the ankle and along the tibial crest. The edema which develops is soft in quality and varies in degree as the posture is altered; that is, elevation of the extremity to a position higher than the level of the heart decreases the swelling. This serves to distinguish the edema of venous stasis from the brawny or firm edema caused by lymphatic blockage;<sup>207</sup> also from the non-pitting, fixed, and organized thickening observed with hypothyroidism (myxedema) or with Milroy's disease. The dilated superficial veins of the extremity are visible as cords or knots and when stasis is extreme purpuric discolorations appear along the course of the vessels. With long standing stasis the color changes to a brownish pigmentation due to secondary alterations in the hemoglobin derived from red blood cells which have found their way into perivascular tissues.

The abdominal phase of the picture of iliac vein obstruction is produced by stasis within the three uppermost tributaries of the great saphenous vein which drain the lower anterior abdominal wall, the upper anterior thigh and the scrotum. These venous branches pass downward onto the thigh, entering the great saphenous just below the point where it passes through the foramen ovale into the femoral vein. The blood, then, passes upward to the right heart by way of the inferior vena cava. The names of these vessels indicate their courses. 1. The super-

ficial circumflex iliac vein passes downward and inward, draining the lateral lower abdominal wall (L. *circum*, around, + *flecto*, to bend; and iliac, pertaining to the flank, i.e., bending around the flank). 2. The superficial epigastric vein travels downward to the saphenous, crossing the middle of Poupart's ligament (Gr. *epi*, upon + *gaster*, the belly). 3. The superficial pudendal vein drains the external genitals. (L. *pudendare*, to be ashamed). These vessels not only become the seats of stasis, as is true of the other veins involved in external iliac obstruction, but in addition, because of their upward direction, they offer an avenue for escape toward the superior vena cava when inferior vena caval blockage prevents the passage of blood by its normal route. To effect this rerouting the direction of the blood current within these veins must be reversed. Methods for detecting this change are discussed later. It is not uncommon in cases of acute appendicitis to find engorgement of the right superficial circumflex iliac vein<sup>208</sup> and its prominence is the rule with ileocecal tuberculosis or enlarged ileocolic tuberculous glands. It must be recalled that with great wasting of the body all superficial veins may appear abnormally visible, even when not the seat of stasis; yet when engorgement is marked and particularly when one vein, or set of veins, upon the abdominal wall stands out from the remainder, venous back-pressure may be assumed and some intra-abdominal pathological process held to be likely.

Obstruction to the common iliac vein shows not only the evidences in the lower extremity and anterior abdominal wall of the involved side as just described, but also yields venous engorgement in the tributaries of the hypogastric vein (O. T. internal iliac) (Fig. 154B). Thus there tends to be added to the picture enlargement of the veins of the buttocks and of the back of the thigh (superior and inferior gluteals); engorged veins on upper, inner aspect of thigh (obturator veins); penile and preputial engorgement or distention of clitoris (internal pudendal); prostatic or vaginal engorgements (local venous plexuses); vesicular varicosities, yielding dysuria, occasional

red blood cells in the urine or even frank hematuria (vesicle plexus); and external hemorrhoids (inferior hemorrhoidal veins). The hemorrhoidal veins, it should be noted, are the only set which become the seat of stasis both with obstruction of the inferior vena cava (systemic circulation) and of the portal vein or its tributaries (portal system). And by the anastomosis of the inferior hemorrhoidal veins (tributaries of hypogastrics) with the superior hemorrhoidal veins (tributaries of the inferior mesenteric veins and portal system) these two great venous systems are connected. The left common iliac vein is longer than the right because the inferior vena cava passes up the right side of the vertebral column and the left vein in passing over the vertebral bodies is particularly subject to pressure with resulting stasis. It is also worthy of note that the obturator nerve lies in close proximity to the common iliac vein at its point of origin at the sacroiliac joint; hence pain along the inner aspect of the knee (obturator nerve pressure) associated with these signs of venous obstruction or stasis serves even more clearly to localize the causative pathological process.<sup>209</sup>

Venous obstruction to the inferior vena cava itself produces the described evidences upon both sides of the body, though involvement of one side may antedate gross involvement of the other. With marked degrees of caval obstruction (thrombosis) the anterior abdominal wall circulation becomes reversed and the venous current passes from below upward along the superficial epigastric and superficial circumflex iliac vessels to reach the lateral abdominal walls and (for the most part) the axilla (lateral thoracic veins; see details further on). Accordingly dilated veins on the lateral portions of the anterior abdominal wall are referred to as the "caval collaterals" in contradistinction to dilated veins about the umbilicus as seen with portal obstruction (the "portal collaterals") (Fig. 155). With obstruction of the inferior cava ascites becomes a prominent part of the clinical picture (see Fig. 154c). And when the level of the obstructing process is above that of the entrance

of the renal vein, renal stasis (albuminuria, tubal casts, and even hematuria) becomes superimposed. Here the absence of edema of the eyelids, of high blood pressure, dilated left heart,

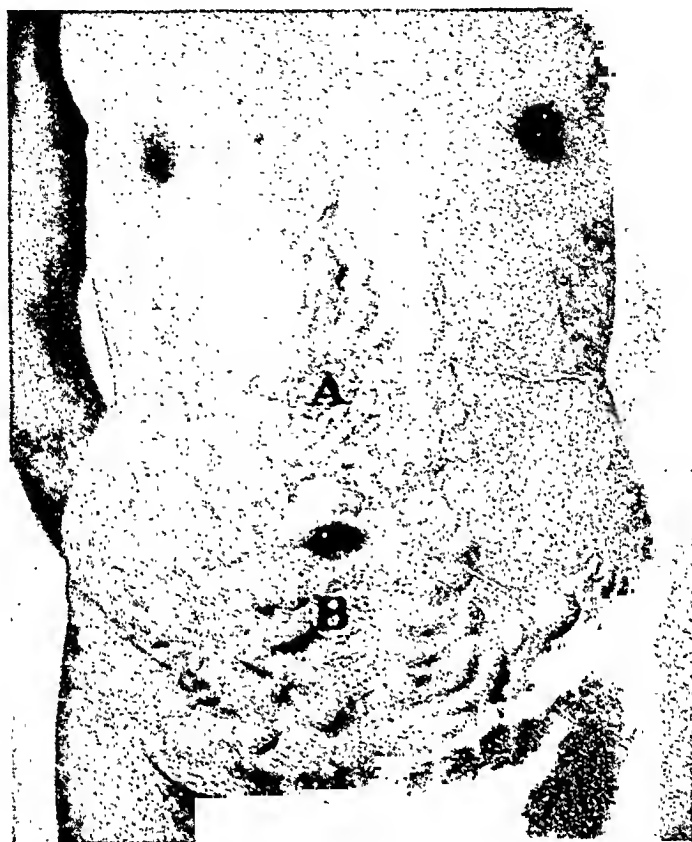


FIG. 155. Portal collateral superficial veins (A) and caval collateral superficial veins (B).  
(From Quervain.)

accentuated aortic second sound, and other evidences of true kidney disease aid in determining that the urinary findings are due to simple stasis of the venous supply of the kidney.<sup>210</sup>

The direction of the blood current in a vein may be detected as follows: select a part of the vein free from branches (Fig. 156); express the blood from this segment by means of two fingers put close together, then drawn asunder while light even pressure is maintained over the vein by each finger; when the vein is empty lift one of the two fingers and note whether the vein fills and how rapidly; repeat the procedure, this time

removing the other finger. By this test it is ordinarily easy to determine the direction in which the blood stream is moving.<sup>211</sup> The procedure may be practiced and tested upon the dorsum

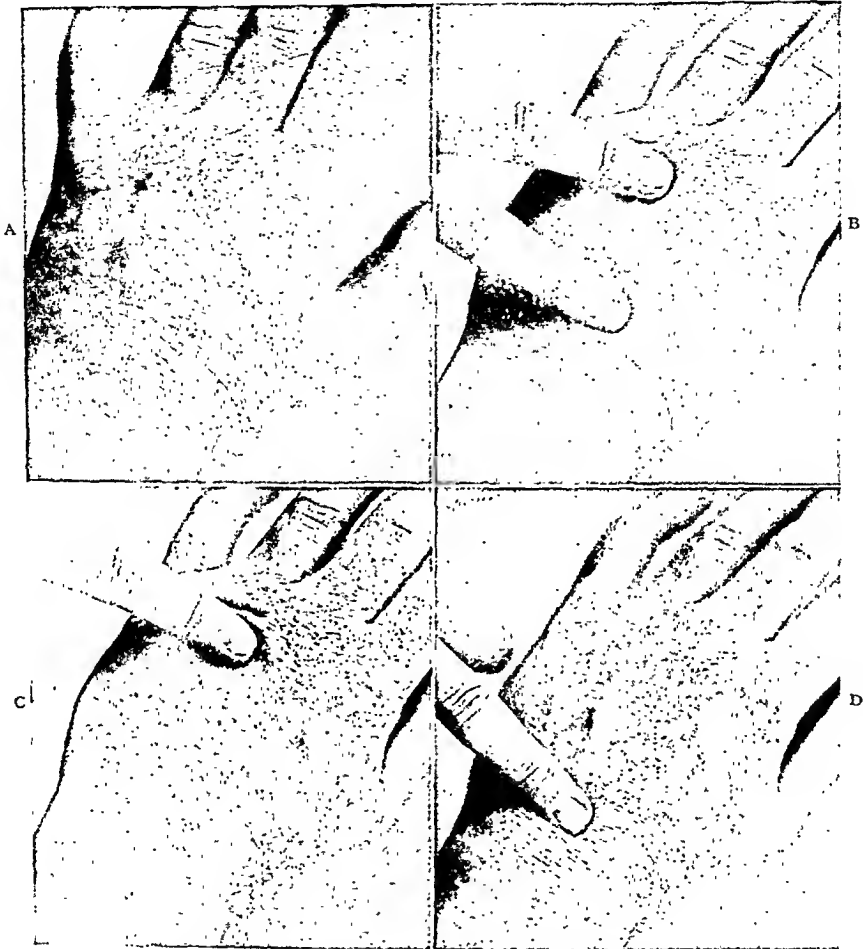


FIG. 156. Method for testing direction of venous current.

A. Prominent veins. B. Obliterating a vein by stripping. C. Lifting proximal finger (vein remains obliterated). D. Lifting distal finger (vein suddenly fills).

of the hand, held considerably lower than the heart to render the veins salient. A second method is to use a single finger, carrying it lightly along the course of the vein; when traveling *with* the current the blood chases along after the finger, keeping the vein filled; when traveling *against* the current the vein

remains empty in the area over which the finger has passed unless a branch has been reached, when the emptied segment suddenly fills. In the veins in question (caval collaterals) the



FIG. 157. Varicose thoracic and abdominal veins in a case of syphilitic mediastinitis of long duration. (From French.)

normal current is downward, for these vessels take blood from the lower abdomen to the thigh, then inward and upward by way of the external iliac vein, common iliac vein, and inferior vena cava to reach the right auricle. With a reversal of the current the blood flows *upward* on the lower anterior abdominal wall ultimately to reach the superior vena cava, chiefly by way of the axilla (passing by the lateral thoracic veins into the axillary veins) or to the regions of the ribs, breasts and diaphragmatic attachments (penetrating branches of intercostal



veins to reach the azygos and hemiazygos veins, and through them the superior cava; penetrating branches of internal mammary veins and through these into the innominate; penetrating branches of the musculophrenic veins to terminate in the internal mammary vein) (see Fig. 154B). Because of these various routes which disperse the obstructed blood the superficial varicosities are most marked immediately about Poupart's ligament.

Superficial abdominal veins may be dilated because of mediastinal as well as from intra-abdominal obstructions (Fig. 157). But in the former instances the obstruction is to the superior vena cava or its tributaries so that the blood current is downward over the thoracic and anterior abdominal walls. The varicosities are *not* most marked over Poupart's ligament but about the shoulder girdle and upper thoracic cage; the arms, neck, mouth and head show venous dilatations never observed as a result of inferior vena caval obstructions (Fig. 154D). Upon such grounds the differentiation of these obstructions is quite simple.

The foregoing anatomical review of the results of venous obstructions at higher and higher levels within the pelvis and abdomen is made more valuable when considered in the light of known clinical findings concerning caval obstructions. The three great groups of conditions which cause venous embarrassment are (1) thrombosis (without external obstruction), (2) local compressions (chiefly due to involvement of adjacent retroperitoneal glands), (3) marked increases in the general intra-abdominal tension as with ascites.

Thrombosis accounts for almost every case in which the caval collateral circulation is extremely marked. Since thrombotic plugging completely occludes the vessel all of the blood is rerouted and the reversed direction of the venous current in the affected superficial veins is readily demonstrable. Inferior vena caval thrombosis usually starts in a smaller tributary either in the thigh or pelvis and spreads upward.<sup>212</sup> The onset is sudden. Edema of the leg is an initial symptom. Usually a single

extremity is first involved. Both extremities become implicated when the ascending thrombotic process reaches the junction of the common iliac veins situated at the level of the fifth lumbar vertebra.

Local compression of the vena cava is usually due to involvement of the retroperitoneal lymph glands adjacent to this vessel.<sup>215</sup> And whereas enlarged glands of Hodgkin's disease or tuberculosis may produce mild signs of stasis it is the hard lymphadenopathies of carcinoma which account for most instances of marked or moderate caval stasis not due to thrombosis or ascites. These malignant lymphadenopathies are usually secondary in nature. Venous blockage due to free intraperitoneal tumors is rare.<sup>213</sup> Such masses tend to slide over the peritoneal surface to other parts of the peritoneal cavity rather than to press directly upon the retroperitoneal vessels. And a small hard gland located in juxtaposition to the inferior vena cava causes obstructive symptoms more often than does a much larger mass free within the cavity.

Increased general intra-abdominal pressure, when of considerable degree, causes flattening of the inferior vena cava and interferes with the flow of blood to the heart. Stasis from such a condition is, however, a late sign and the true diagnosis of the cause of both the pressure increase and the late venous obstruction is usually arrived at from earlier signs and symptoms.

When hematuria is followed by the secondary development of venous evidences of inferior caval obstruction it is likely that a malignancy of the kidney is being dealt with and that an early involvement of the renal veins has led to an extension to the cava, possibly as a malignant thrombosis, or that secondary malignant lymphadenitis has developed.<sup>214</sup> When the enlarged superficial veins appear before the onset of hematuria a primary malignancy of the kidney is unlikely.

Visibly dilated veins form but a part of the clinical picture of portal obstruction. This might be described as follows:

1. chronic dyspepsia; 2. hematemesis; 3. ascites; 4. splenic

enlargement; 5. dilated veins. Hematemesis is more frequent with portal obstruction than with actual gastric disease.<sup>215</sup> In differentiating the condition it is to be borne in mind that the clinical picture of cirrhosis is more extensive than that of peptic ulcer (ascites, internal hemorrhoids, engorged superficial veins, evidences of alcoholism). Simple diapedesis, or actual rupture of a dilated vein within the stomach or esophagus explains the origin of the bleeding with portal obstruction. The amount of the bleeding varies accordingly (hematemesis, melena, occult blood). When cirrhosis of the liver is the cause of portal obstruction a fine tremor of the tongue and fingers, an alcoholic facies, and often a slight chronic jaundice are added to the picture. A tendency to diarrhea is also common, probably due to the accumulation of fluid within the lumen of the bowel as a result of diminished activity within the absorptive functional third of the gastrointestinal tract (stasis).<sup>216</sup>

The collateral circulation with portal obstructions has previously been shown (see Fig. 22). The surface engorgement, it will be noted, is chiefly about the umbilicus and is located toward the center of the upper abdomen. Many of the vessels which become dilated are deeply situated and are encountered by the operator rather than by the clinician. Indeed the degree of the surface venous engorgement offers some basis upon which to estimate the amount of dilatation of the deeper anastomotic channels. At times a single superficial dilated vein calls attention to the condition (Fig. 158). A true caput Medusae is rare, being encountered "chiefly in textbooks." The relation of the superficial abdominal veins to the two great venous systems (portal and systemic) is illustrated by this observation: when a malignant nodule about the porta hepatis has caused venous dilatation of the periumbilical veins (portal collaterals) and at the same time ascites with swelling in the extremities and dilated lower abdominal veins (caval collaterals), the removal of the ascitic fluid by tapping will be followed by a disappearance of the caval collateral vessels while the

portal set remain engorged; that is, removing the weight of the ascitic fluid from the inferior vena cava ends engorgement of the caval veins but because of the continuation of the



FIG. 158. Often a single dilated superficial vein calls attention to portal vein obstruction.

pressure on the portal vein by the malignant nodule the portal collaterals remain dilated even after abdominal paracentesis.<sup>213</sup>

Considering together all degrees of portal obstructions cirrhosis of the liver accounts for about 90 per cent of cases.<sup>217</sup> But the causative lesion with those severe grades in which the veins of the anterior abdominal wall are markedly distended is usually a malignant nodule pressing firmly against the portal vein near the porta hepatis.<sup>213</sup> Softer lymphadenopathies, as

those of tuberculosis, Hodgkin's disease or lymphatic leucemia, more rarely obstruct the vein. That the site of the malignant obstruction is not ordinarily within the liver itself is shown by

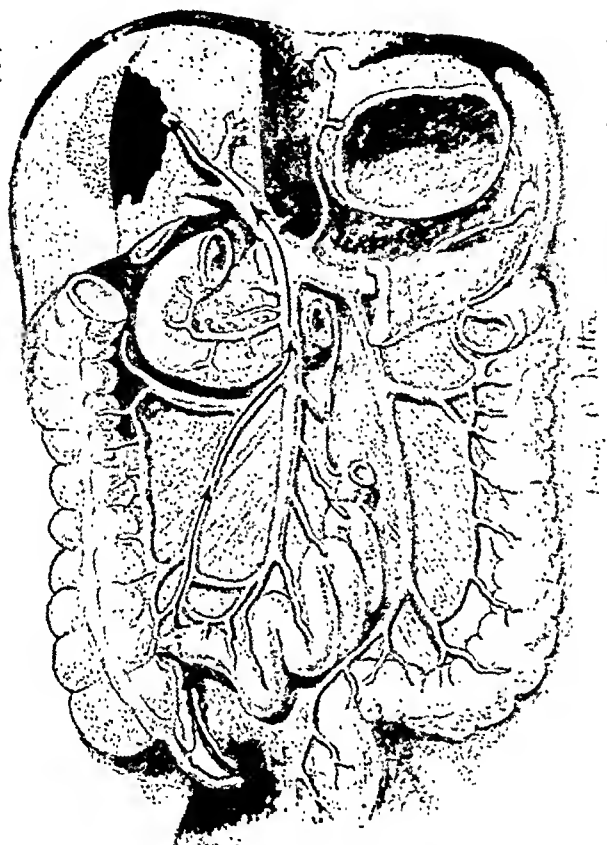


FIG. 159. A. Pylephlebitis; septic embolus reaching liver from infected appendix.

the fact that when the portal lymphatic glands have escaped involvement, multiple tumors may exist within the liver without causing the least evidence of portal stasis. And even when the liver is found to contain one or more nodules the likely cause of the stasis is some additional nodule, even though smaller, along the course of the vein. Because of the relation between portal vein and common bile duct the latter often is simultaneously involved, adding deepening jaundice to the picture. And while an impacted stone within the common

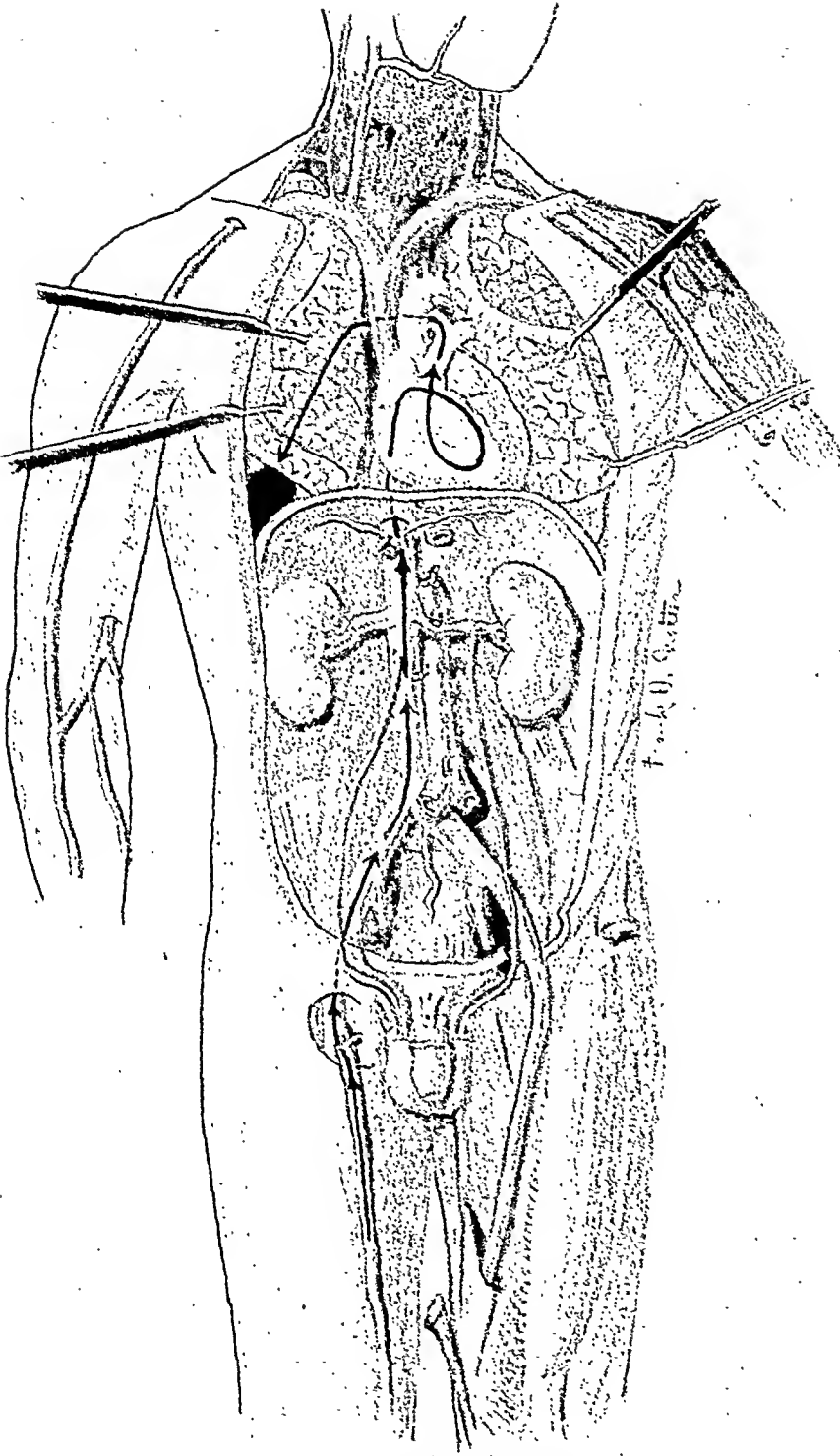


FIG. 159. B. Systemic embolus reaching right pulmonary base from long saphenous vein.

duct is the most frequent cause of gradually deepening jaundice or of waxing and waning jaundice (ball-valve action), stones do not account for simultaneous interference with the portal vein. Hence the association of deep jaundice, ascites, and dilated superficial veins constitutes presumptive evidence of some neoplastic condition near the porta hepatis (gateway of the liver), probably a malignancy. (For the differentiation of the many causes of ascites see p. 186.) Thrombosis of the portal vein is quite rarely the cause of portal obstruction.<sup>215</sup> And when this is the cause the thrombosis is usually of the septic type (pylephlebitis), the result of extension from some septic focus within the portal drainage area (appendicitis). Here the chills, fever, and other evidences of sepsis so dominate the picture that the venous dilatation is of less importance as a diagnostic aid than with the more chronic forms of portal stasis.

Under the heading "the rôle of blood vessels in determining anatomical arrangements within the abdomen," the relation of the portal vessels to the lobes of the liver will be dealt with and further anatomical details concerning the tributaries of the portal system discussed.

The liver serves as a filter for emboli which originate from veins of the portal system (Fig. 159A). Inflammations of the appendix account for the majority of cases of hepatic embolism and of portal thrombosis.<sup>219</sup> Here the route of travel is through the ilioocolic vein, the superior mesenteric vein, and the portal vein to the liver. Septic emboli set up a pylephlebitis or cause multiple abscesses in the liver; bland emboli cause infarction. Upper abdominal operations (on gall bladder, stomach, duodenum) or any within the sphere of the portal system (resection of omentum, resection of bowel, etc.) may produce secondary changes in the liver as the result of extension along the veins; pelvic operations, on the other hand, are more seldom followed by liver complications for pelvic veins drain into the systemic circulation by way of the iliac veins.<sup>220</sup> Systemic emboli lodge in the pulmonary artery or its branches

(Fig. 159B). Such emboli may reach the right side of the heart from any of the veins which drain into the inferior vena cava (saphenous veins, femorals, iliacs, uterine, renal). Death within ten minutes is the rule when the main pulmonary trunk is blocked. Emboli small enough to pass the main trunk lodge in the finer branches of the pulmonary artery. The right base is more frequently involved than the left since the right branch of the pulmonary artery is larger than the left.<sup>221</sup> Dyspnea, orthopnea, coughing up of frothy sputum, hematemesis, and sharp precordial pain are outstanding symptoms of pulmonary embolism. Roentgenograms may aid in differentiating pulmonary infarction from bronchopneumonia and, lobarpneumonia or massive collapse of the lungs (triangular shadow near lung periphery; sharp outlines; predilection for right base).<sup>222</sup> Embolism occurs with half the cases of postoperative thrombosis. The incidence of thrombosis following abdominal and pelvic operations is stated to be from 1 per cent to 4 per cent or more of cases; embolism occurs, accordingly, in from .5 per cent to 2 per cent or more of cases.<sup>223, 224</sup> The incidence of thrombosis is reduced by gentle handling of the tissues at the time of operation. And by avoidance of massage or movements at sites of thrombosis the percentage of incidence of embolic phenomena is lowered.

Pregnancy is the most frequent exciting cause of varices of the vulval veins and if the varicosities antedate gestation the condition is always aggravated during this period.<sup>225</sup> Other causes are pelvic tumors, uterine displacement, laborious occupations in the standing position; but pregnancy is so far the most common cause that the presence of large vulval varicosities should at once excite suspicion of the presence of this condition (Fig. 160). Nearly every pregnant woman has one or more phlebectasiae within the lower half of the body. Varicosities are marked in 20 per cent; the usual sites in the order named are the legs, vulva, mons, pelvis, rectum, anus, vagina, abdomen, buttocks.<sup>226</sup> Venous dilatations may become marked in the earliest weeks of pregnancy and may totally disappear



within a few weeks post partum or even after fetal death and before the uterus has been emptied. These facts suggest that mechanical pressure is not the sole cause of the condition; the



FIG. 160. Varicose veins of vulva. (From DeLee's Principles and Practice of Obstetrics. W. B. Saunders Co.)

specific gravity of the gravid uterus is about the same as that of the intestinal mass. The contrast between the rarity with which free intra-abdominal and intrapelvic tumors give rise to the extreme degrees of varicosities (particularly of the vulva) and the frequency with which pregnancy will produce them, leads to the conclusion that when pregnancies and free pelvic tumors are being differentiated the presence of large vulval varices points strongly toward pregnancy.

The common type of varicocele is located upon the left side and involves chiefly the pampiniform plexus (spermatic veins proper) while the veins of the vas are implicated to but a limited degree. To be differentiated from this usual variety is the so-called symptomatic varicocele which is secondary to and caused by some abnormal condition within the abdomen. Ninety per cent of varicoceles occur upon the left side, 10 per cent are bilateral, while less than 1 per cent are found upon the right side only.<sup>227</sup> The normal predilection for the left side is ordinarily ascribed to the fact that the left testicular vein enters the left renal vein at a right angle while the right testicular vein enters directly into the inferior vena cava, taking an oblique and non-obstructing course (see Fig. 165). The left vein also lies below the sigmoid colon where it is subjected to pressures with excessive filling of the sigmoid and with constipation. The left vein, in addition, is longer than the right. Because of this rarity of right-sided varicoceles an enlargement limited to the right pampiniform plexus is to be considered presumptive evidence of some intra-abdominal obstruction of the right testicular vein (symptomatic varicocele). When in addition the veins of the vas are extensively involved the presumption of high obstruction is strengthened. And implication beyond the usual degree, of the veins of the vas occurring on either side, should arouse suspicion that the condition is symptomatic. A kidney tumor (hypernephroma, sarcoma, polycystic kidney), is the most frequent cause of a symptomatic varicocele. Hence in the presence of any varicocele it is a good rule to conduct a careful examination of the loins; and with any marked venous varices, whether of scrotum, labia, legs, or abdominal walls, complete examination of the rectum, vagina and abdomen are indicated.

Large venous varices immediately below Poupart's ligament not infrequently have been mistaken for femoral hernias (Fig. 161). Such an error may be discovered only during the course of an operation when the exposed veins are identified by their bluish color or by excessive bleeding during search

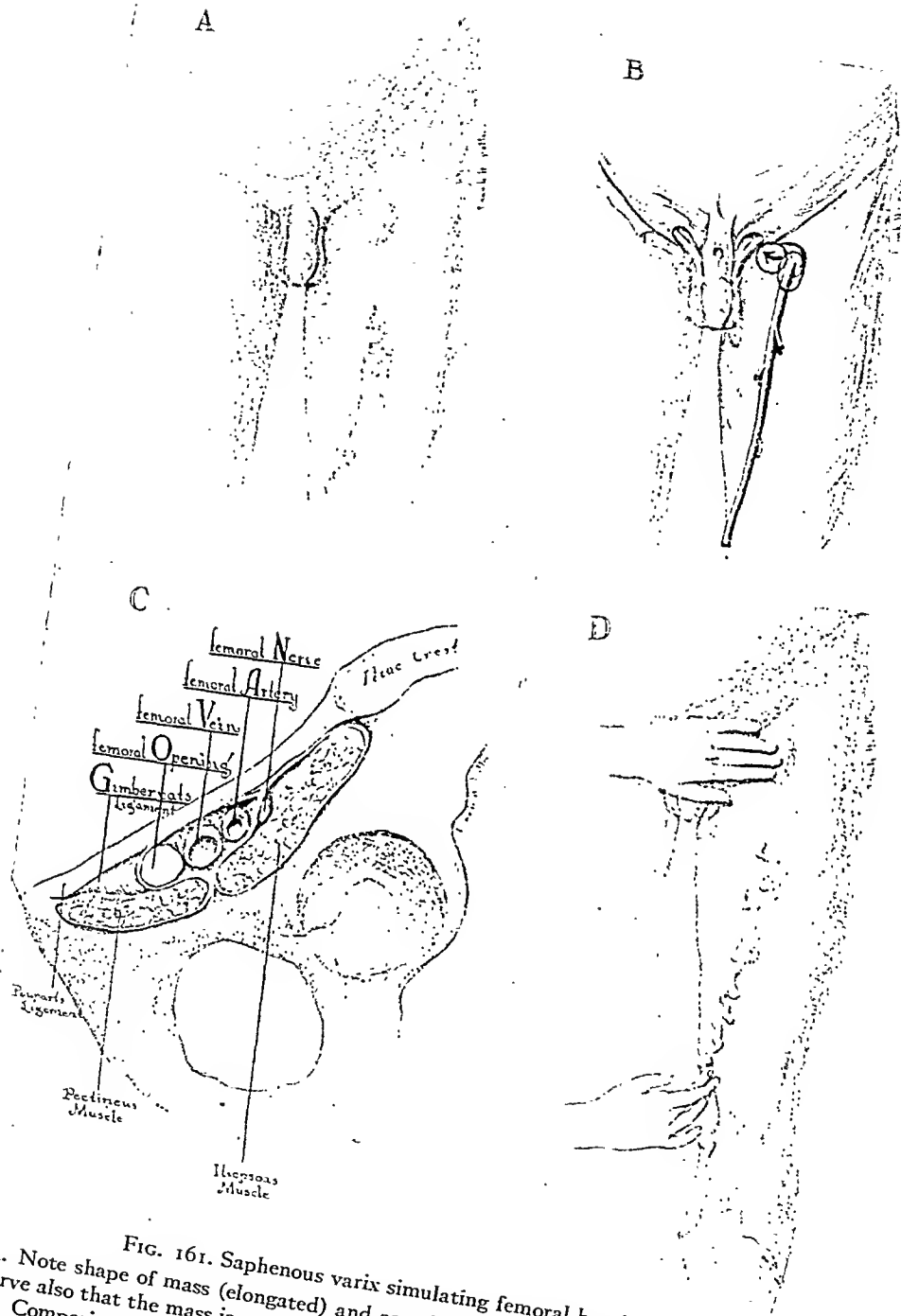


FIG. 161. Saphenous varix simulating femoral hernia.  
 A. Note shape of mass (elongated) and association with varices lower in the thigh. Observe also that the mass is somewhat lateral to the saphenous opening.  
 B. Comparison of position and shape of hernia and varix.  
 C. Structures passing beneath Poupart's ligament.  
 D. Tapping test for saphenous varix.

for a hernial sac. The long saphenous vein enters the femoral vein through the fossa ovalis and it is through this fossa, just medial to the vein, that femoral hernias descend. The structures below Poupart's ligament named from within outwards are Gimbernat's ligament, femoral opening, femoral vein, femoral artery and lateral cutaneous nerve. So closely may a saphenous varix imitate a femoral hernia that diagnostic errors are quite common when examinations are casual and perfunctory; but absolute differentiation of the two conditions should be relatively easy when examinations are careful and complete. Among points to be noted in the study of a mass in the upper and inner part of the thigh are its color, shape, exact location, reducibility, with attention to the ease of reduction, its exact method of attainment, and of maintainment; the presence or absence of a cough impulse, and the presence or absence of special signs or tests. With a varix the color is bluish and is situated below the skin; with a hernia, if there is a color alteration such as produced by irritation or the wearing of a truss, the hue is reddish or that of a brown pigmentation and is situated within the skin. While a hernia is rounded or ovoid a varix tends to follow the axis of the vein, being elliptical or elongated. As to location the varix lies lateral to and below the site for a femoral hernia which is immediately adjacent to Gimbernat's ligament. The cough impulse with a varix is a characteristic thrill resembling the passage beneath the finger of a jet of water. Two points regarding the reduction of a varix are particularly valuable; when the patient is erect direct pressure of the examining fingers causes the mass to disappear but it immediately reappears as the fingers are withdrawn and repeated as often as desired this test proves constant; when the patient is changed to a recumbent posture with his trunk lower than his thighs the mass always disappears spontaneously. Pressure on the femoral canal retains the reduction of a hernia but with a varix such pressure usually causes the mass to reappear and to increase. A hernia reduces with a gurgle when containing gut (enterocele) and with a typical sudden slipping

sensation when the contents are solid (epiplocele), sensations which are not experienced in the reduction of varices. Perhaps the most valuable tests and those pathognomonic of varices have to do with the transmission of a fluid wave. Tapping lightly over the mass (varix) gives rise to a visible impulse in associated varicosities in the neighborhood of the knee;<sup>225</sup> and tapping upon varicosities at or even below the knee causes a visible expansion of the mass in the groin and transmits an unmistakable wave impulse to a palpating hand held quietly over the mass. (See April issue, p. 156.)

The deep epigastric artery serves as a landmark in differentiating direct from indirect hernias. A direct hernia is always acquired and pushes its way outward through Hesselbach's triangle, not along the inguinal canal. Hesselbach's triangle is a small space bounded below by the inner portion of Poupart's ligament, medially by the margin of the rectus muscle and laterally by the deep epigastric artery. The deep epigastric artery is given off from the external iliac artery immediately above its termination below the middle of Poupart's ligament to form the femoral artery. The deep epigastric passes upward and inward lying between the peritoneum and the transversalis fascia; after forming the outer boundary of Hesselbach's triangle it reaches the rectus muscle the posterior sheath of which it enters, ascending behind the muscle to anastomose with branches of the internal mammary and inferior intercostal arteries. When viewed from the inside the anterior abdominal wall immediately above Poupart's ligament shows three depressions of peritoneum (inguinal peritoneal fossae (Fig. 162) of which the external (fovea inguinal lateralis) corresponds to the abdominal inguinal (internal) ring while the middle and internal lie to either side of the obliterated hypogastric artery. These latter foveae (middle and internal) both lie within the limits of Hesselbach's triangle and it is through one of these that a direct hernia bulges. Hence the direct hernia protrudes from behind the external inguinal ring and it escapes on coughing even when pressure

is made over the internal (abdominal) ring, a fact which also serves to distinguish a direct from an indirect rupture.<sup>229</sup> In examining for an inguinal hernia it is suggestive when the finger

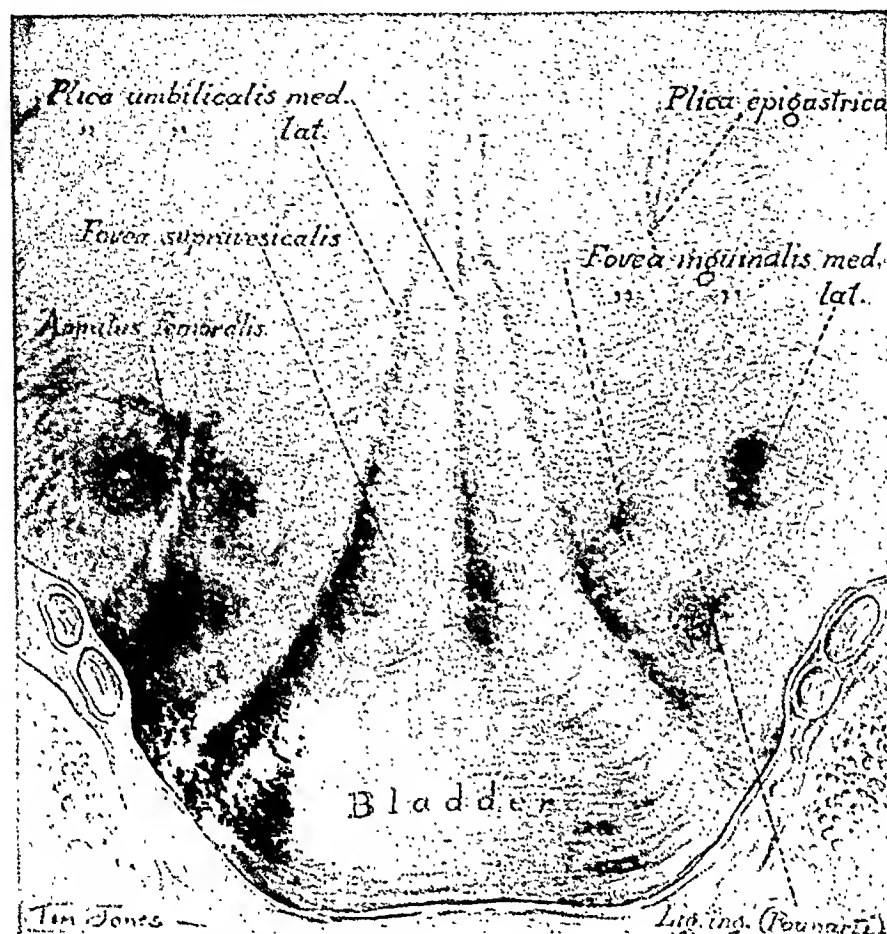


FIG. 162. Inguinal foveae or pouches.

Fovea lateralis lies external to deep epigastric artery.

Fovea medialis is situated between inferior epigastric and obliterated umbilical arteries.

Fovea supravesicalis lies to medial side of obliterated umbilical artery, namely between it and the urachus.

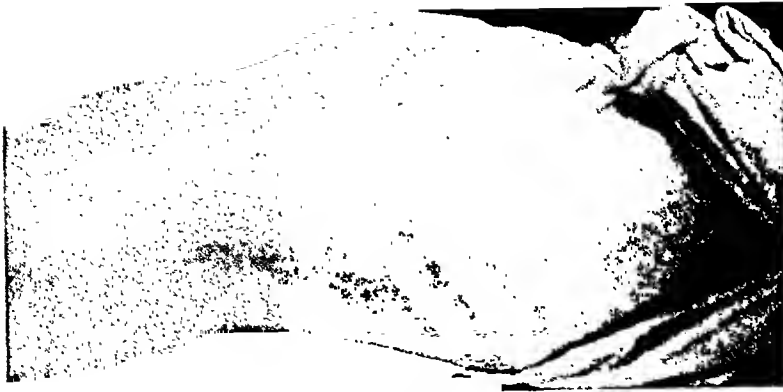
Indirect hernias originate at fovea lateralis, whilst direct hernias originate at fovea medialis. (From Hertzler's *The Peritoneum*, Mosby.)

passes directly backward into the abdomen below the external ring instead of upward and outward along the inguinal canal; but the only way in which to be certain that a hernia is truly direct is to see the relation of artery and hernial bulge at

operation or to feel the pulsation of the deep epigastric artery lateral to the origin of the hernia (neck of hernial sac). The identification of inguinal hernias as direct and indirect is perhaps more of anatomical than of surgical interest. This exact preoperative diagnosis is somewhat academic for at operation the inguinal canal is opened sufficiently in either case to completely expose the floor of the inguinal canal and to show the degree to which it is weak and the exact nature of the weakness.

An additional use of an artery for diagnosis is the femoral test for hypogastric peritonitis.<sup>230</sup> This test, while not proposed as one of outstanding value, is, nevertheless, of considerable interest and should be kept in mind for use in selected cases as part of the diagnostic routine. The sign is based upon the fact that the external iliac artery, lying below the posterior parietal peritoneum and upon the psoas muscle, may be engorged by digital pressure over the femoral artery near its origin, thus backing up the arterial current in such a fashion as to cause the patient pain when the peritoneum over the iliac vessel is the seat of inflammation. The fingers of the diagnostician are pressed firmly upon the patient's thigh immediately below the middle of Poupart's ligament, obliterating the femoral arterial pulse; the patient now complains of a deep-seated throbbing pain if there is inflammatory involvement of the peritoneum along the course of the external iliac artery. When the femoral test is positive the psoas test (see p. 75) will probably also be found positive. Both signs give presumptive evidence of a local inflammatory process but neither serves to identify the primary cause of the peritonitis or to distinguish this from a localized retroperitoneal involvement.

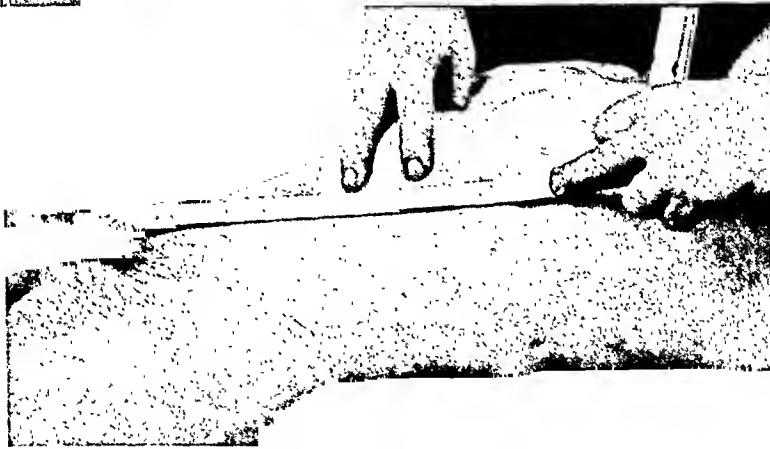
In the diagnosis of any aneurysm the expansile quality of the pulsation is the outstanding characteristic (Fig. 163A-C). Within the arterial widening or sac the transmitted force of the cardiac ventricular systole is carried to all parts of the interior, according to the laws of hydraulics, and the elastic aneurysmal wall, unless there be extensive clotting within, undergoes



A



B



C

FIG. 163. Aneurysm of abdominal aorta.

- A. Tumor as seen on simple inspection.
- B. Palpating mass to elicit expansile pulsation.
- C. Measurement of lateral movement of fingers in detecting expansile character of pulsation. (From Third Surgical Division of Bellevue Hospital.)



enlargement or dilatation in all directions. When the aneurysmal mass is superficial in location, is plainly visible and can be handled, this expansile quality is not difficult to detect. The



FIG. 164. Lateral view of tumor of abdomen due to aneurysm of common iliac artery causing prominence in right iliac region. Note extensive varicose veins along outer aspect of thigh.

(From Eisendrath's Surgical Diagnosis, W. B. Saunders Co.)

separation of any two points on the surface may be accentuated by attaching two indicators (bits of paper, matches) over the bulging mass and noting the lateral excursion of the upper extremities of the indicators. Digital pressure over the artery proximal to the mass causes it to reduce in size and the expansions to diminish. When, however, the aneurysm is within the abdomen (aorta) these simple and often conclusive tests are not applicable for the mass is more deeply situated and is likely to be covered by bowel or some other intra-abdominal structure. Here chief reliance for the detection of expansile pulsation must be placed upon the clinician's tactile sense. The examining hand is placed over the mass, the fingers encircling the tumor and being held equidistant from one another; the pulsation, as it impinges upon the fingers, spreads them slightly apart. At times this lateral motion may be seen as well as felt. When the mass is not an aneurysm but has a pulsation which is merely transmitted to it from an

adjacent artery it has an upward and downward but no lateral or expansile motion, for the true expansile quality is only possible when the interior of the mass communicates with the blood stream. The diagnosis of an abdominal aneurysm may be aided by a history suggesting an adequate etiology (syphilis, injury), by evidences of arterial changes at other points (collateral circulation, delayed distal pulse, inequalities in different arterial pulse times), and by the presence of a thrill, hum, or bruit over the mass (Fig. 164). Yet the one pathognomonic sign is the demonstration of true expansile pulsation.

After an abdominal examination, local redness or hyperemia is sometimes noted to be definitely more marked in some particular region of the abdominal wall. This is usually over the point of maximal rigidity, tenderness or hyperesthesia. When the phenomenon is observed the casual explanation often given is that this area has been palpated with more vigor or longer than other regions. Yet upon more careful study of such cases it is found that the increased redness occurs when the skin irritation is of but the slightest degree and that vigorous irritation elsewhere on the walls fails to produce an erythema of equal intensity. Moreover when a series of lines or long light scratches with a fairly sharp object (as an applicator) are made over the abdominal wall the resulting dermatographism is more marked in these definite local areas. When the scratches are made first in one plane, then at right angles to this plane, local dermatographism shows as a red cross sharply demarcated from surrounding skin ("red-cross sign"). Not only are the red lines or crosses more marked and wider than elsewhere and do they appear with lesser degrees of stimuli, but they also persist after the normal dermatographism of other parts of the abdominal walls has disappeared (one to three minutes). The red cross may last for many minutes or for hours. The borders separating the increased erythema or dermatographism from the normal skin are sharp and abrupt, rather than blended indefinitely with adjacent areas. More careful study of this phenomenon shows that it often follows

precise metameric or segmental distribution. The significance of this vasomotor phenomenon as to abdominal diagnosis, and its relation to cutaneous hyperalgesia and altered responses to heat and cold, will be reserved for the chapter dealing with visceral neurology when the relation of spinal cord segmentation to cutaneous zones or fields is dealt with and the subject of vasomotor nerves is considered.

Similarly other vascular phenomena dependent upon vasomotor innervation (such as the relation between splanchnic vasodilatation or constriction and cerebral anemia or fluctuations in the systemic blood pressure) will be taken up with a study of visceral neurology.

Bleeding into the gastrointestinal tract may occur from veins, arteries or capillaries. Following any erosion of the mucous membrane or into deeper structures some amount of blood enters the lumen of the canal; this must be discharged by way of the mouth (hematemesis; coffee-ground vomitus) or by the rectum (frank rectal bleeding; melena; occult blood). The term *hematemesis* is self-explanatory. Coffee-ground vomitus is due to a changing of hemoglobin into hematin by the action of the gastric juice. The passage of bright blood by rectum is termed rectal bleeding; but the passage of dark or altered blood is referred to as melena (Gr. *melas*, black). The black color of the motion is due to the action of digestive juices on the hemoglobin and signifies that the blood has arisen in or passed through the secretory functional division of the tract. The passage of such small quantities of blood that they cannot be detected by inspection is referred to as a discharge of occult blood (L. *occulare*, to hide). Occult blood is detected by the use of chemical tests (guaiacum test; denzedin test) or by use of the spectroscope, (motions acidulated with acetic acid, then extracted with ether, giving a solution of clear blood pigment suitable for spectroscopic study). Concerning blood discharged by these routes and in these varying amounts the clinician has certain generalizations or rules.<sup>231-234</sup>

Vomited blood does not necessarily originate from the stomach; it may have been swallowed and actually have arisen from esophagus, lungs, mouth or nose.

Even when vomited blood actually does arise from the stomach, peptic ulcer is by no means exclusively indicated; gastritis, corrosive poisons, ruptured gastric varices, injuries, aneurysms, neoplasms, are among the possible causes.

Hematemesis, then, points away from rather than toward a diagnosis of gastric ulcer.

Hematemesis is, nevertheless, an important sign of peptic ulcer; it occurs in something less than 25 per cent of cases; it is seldom the initial or only symptom of ulcer; ulcer as a true cause is determined by other evidences (history; x-ray; by exclusion).

The longer gastric symptoms precede hematemesis and the more definite is the associated abdominal pain with relation to meals, the more likely is the vomiting of blood to be due to peptic ulcer.

With males gastric ulcer is the most likely cause when hepatic cirrhosis and the swallowing of blood can be excluded; hematemesis is less likely with duodenal than with gastric ulcer.

Hematemesis occurring in an individual who has had a good appetite but who has feared to eat because eating uniformly sets up pain is quite certain to be due to gastric ulcer.

The older the patient and the more definite the history of alcoholism the more likely is the hematemesis to be due to cirrhosis of the liver.

Cirrhosis of the liver is probably the most likely single cause of hematemesis. (For associated evidences of cirrhosis see p. 189.) While hematemesis from cirrhosis may precede ascites, jaundice, superficial varicosities and other evidences, there will quite surely be found enlargement of the liver and often a palpable spleen; the characteristic facies and tremor will seldom be absent.

Hematemesis from gastric cancer is usually slight when present. The vomiting of blood in any degree occurs with less than 20 per cent of cases of gastric carcinoma; vomited blood from cancer is almost uniformly coffee-ground in character.

Hematemesis is by no means uncommon with blood diseases here it is often associated with epistaxis or bleeding in other parts of the body (purpura; hemophilia; leucemias, pernicious anemia). Gastric bleeding with splenic enlargements has been explained as due to the relation between the vasa brevia and the splenic circulation.

Hematemesis in the absence of a history of gastric ulcer, the absence of evidences of cirrhosis of the liver, and unassociated with enlargement of the spleen should lead to a careful search for some cause for the swallowing of blood.

When epistaxis is present with hematemesis the latter is probably due to the swallowing of blood; but it must be kept in mind that the two most common causes of epistaxis in adults are cirrhosis of the liver and chronic interstitial nephritis.

If blood is obtained by the blowing of the nose the cause of the hematemesis is probably swallowed blood.

Cough, obvious evidences of serious disease of the lung, and the presence of frothy blood lead to the suspicion that any associated hematemesis is due to the swallowing of blood.

With wasting, dysphagia, and presternal distress the presence of a malignant growth of the esophagus or mediastinum should be considered.

A careful examination of the nose, mouth, pharynx, chest, and abdomen is a requisite with every patient complaining of hematemesis.

Concerning the passage of unaltered blood by rectum the following generalization may be made. The source of the bleeding is quite surely some point situated distal to the proximal ileum; blood from the terminal ileum and proximal colon tends to be mixed with the motions; bright blood streaking the motions but remaining unmixed with other discharges presumably arises from a rectal, perirectal or anal disorder; blood mixed with pus signifies some deep ulceration.

Melena is usually associated with some ulcerative lesion within the stomach or duodenum, for the altered color, as previously discussed, is produced by the action of digestive fluids elaborated within the secretory functional division of the digestive tract on the hemoglobin. Gastric or duodenal lesions give rise to bright blood by rectum only in such rare instances as those in which bleeding is copious or the passage through the lower intestinal tract is very rapid.

Occult blood may be caused by any breach of surface at any point within the gastrointestinal tract (ulcers, inflammations, newgrowths, parasites). Occult blood, then, does not in itself serve to identify or indicate any specific lesion. The established presence of occult blood either tends to confirm a diagnosis already presumptively established on other grounds or to indicate the need for detailed study by other methods in order to ascertain its exact cause.

The physical examination or the history may at once clear up any question as to the cause of the specific case of gastrointestinal bleeding.

Anal and perianal lesions (fissures, fistulae, hemorrhoids) may be discovered by local examination of the parts in a good light. Those within anal canal, rectum and lower sigmoid (neoplasms, ulcers) are quite certainly to be detected by rectal digital or sigmoidoscopic examinations, providing the rectum is reasonably free of impacted feces.

When a sausage-shaped mass is palpated within the abdomen of an infant complaining of sudden severe abdominal pain, an associated bloody diarrhea is almost certainly caused by intussusception.

Combined slimy (mucus) and bloody discharge associated with cramp-like pain in the region of the colon is likely to be caused by mucous colitis. Tenesmus, low sacral or perineal pains suggest pathological conditions within the lower colon or rectum.

Headaches, epistaxis, fever, rose spots and a large spleen, or a leucopenia, combined with diarrhea or the passage of blood, indicate typhoid fever (Widal test).

A tuberculous ulcer as a cause of blood per anum is unlikely unless definite signs of pulmonary tuberculosis are also present, for tuberculosis of the bowel is rare without previous thoracic involvement.

Bloody diarrhea quickly following sudden symptoms of collapse and severe abdominal pains, and occurring in a patient known to be suffering from aortitis or heart disease, particularly a malignant or ulcerative endocarditis, leads to the strong suspicion that an embolus has plugged the superior mesenteric artery; the same picture may be caused by mesenteric thrombosis following an abdominal operation.

Blood by rectum in association with epistaxis, petechiae, joint pains, or evidences of any bleeding elsewhere within the body should suggest purpura hemorrhagica or hemophilia.

When there is weakness, anemia, high blood pressure, enlargement of the heart (dilated left ventricle) and when albumin and casts are discovered in the urine the anal blood may arise from a chronic Bright's disease.

Frank rectal bleeding, copious, and with blood unmixed with motions, occasionally occurs with cancer of the rectum, but far more often arises from a hemorrhoid or rectal polyp. The anal discharge typical of cancer is watery and foul and may contain broken-down neoplastic masses.

Faced, then, with the presence of blood discharged per anum the clinician searches for typical clinical pictures of conditions known to be causes of such a discharge and examines his patient thoroughly with all possible causes in mind; he is aware, however, that the most likely single cause of occult rectal blood and of melena is peptic ulcer. (Associated findings with peptic ulcers have been dealt with on pp. 259 and 260.)

The vascular system requires careful study, also, in order that its own disorders may be distinguished from those of intra-abdominal organs. Passive congestion of the liver with uncompensated heart disease is sometimes mistaken for an inflammation of the gall bladder. Sudden embolic plugging of the superior mesenteric artery closely simulates acute intestinal

obstruction of the mechanical type. Ptechieal hemorrhages with purpura are perhaps as common in mucous membranes as in skin and it is not surprising that with Henoch's purpura when the terminal ileum and appendix are the sites of hemorrhagic infiltrations the findings upon abdominal examination alone should imitate almost exactly the signs produced by an acute inflammatory involvement of the region (acute appendicitis). Edemas of the enteral wall with allergic phenomena (food idiosyncracies) and with Von Quincke's disease (angio-neurotic edema) tend to disappear spontaneously with almost the same degree of safety as do analagous swellings of angio-neurotic origin situated in superficial regions; yet ill-advised operations are not infrequent (diagnostic errors) with these conditions. The mimicry of gastric carcinoma by cirrhosis of the liver is so well-known that patients recognized to be suffering from the chronic dyspepsia of cirrhosis may be allowed to develop advanced cancer before receiving radiographic study, in cases where gastric malignancy has become superimposed upon the liver disorder. Diagnostic difficulties with tabes dorsalis, plumbism and brain tumor need but to be mentioned to be fully appreciated. Angina abdominalis, similar in mechanism to cardiac angina, is characterized by intermittent attacks referable to individual abdominal organs and the origin of these visceral crises is so easy to overlook that it seems a good rule routinely to examine the patient's feet when long-standing attacks of vague intermittent abdominal disturbances are complained of in order that vascular changes typical of arteriosclerosis or of Raynaud's disease do not pass unrecognized.

Many such points relative to the relation of veins and arteries to abdominal diagnosis cannot, due to lack of available space, be adequately dealt with here but may be studied in general medical textbooks. Needless operations and diagnostic blunders are unavoidable unless the surgeon (diagnostician) is well acquainted with the manifestations of medical conditions which simulate diseases within his own domain; or unless pre-



operative consultations with internists are secured with sufficient frequency when clinical pictures arouse suspicion because atypical. How can diagnostic errors be avoided when the condition from which the patient actually suffers falls outside of the vocabulary or outlook of the surgical diagnostician who acts as sole judge and dictator of the patient's destiny? No amount of conscientious gathering of additional data will lead to a correct conclusion unless in the correlation and interpretation of the data the viewpoint and knowledge of the diagnostician be sufficiently broad. Collateral reading and study by the surgeon outside of his own domain and consultations on all problem cases offer the only protection to the patient afflicted with some non-surgical disorder which simulates an intra-abdominal surgical disease.

2. SURGICAL MANAGEMENT OF ABDOMINAL VESSELS. The abdominal aorta begins at the aortic opening in the diaphragm opposite the lower border of the last thoracic vertebra and extends to the level of the body of the fourth lumbar vertebra where it terminates to the left of the midline by bifurcating into the right and left common iliac arteries (Fig. 165). This great vessel traverses, then, the epigastric and umbilical region of the abdomen, its point of termination being opposite a transverse line connecting the summits of the iliac crests, that is, about  $\frac{3}{4}$  in. below and to the left of the umbilicus. The branches of the abdominal aorta are the following:<sup>235</sup>

Visceral		Parietal	
Unpaired	Paired	Unpaired	Paired
Celiac	Suprarenal	Middle sacral (which is the original continuation)	Inferior phrenic
Superior mesenteric	Renal		
Inferior mesenteric	Testicular or ovarian		Lumbar (four pairs) Common iliac

The gastroenterologist is chiefly interested in the three unpaired visceral branches, celiac axis, superior and inferior mesenteric

arteries, which form the entire arterial supply of the gastrointestinal tract. The celiac axis (abdominal whorl) arises from the front of the aorta between the crura of the diaphragm opposite

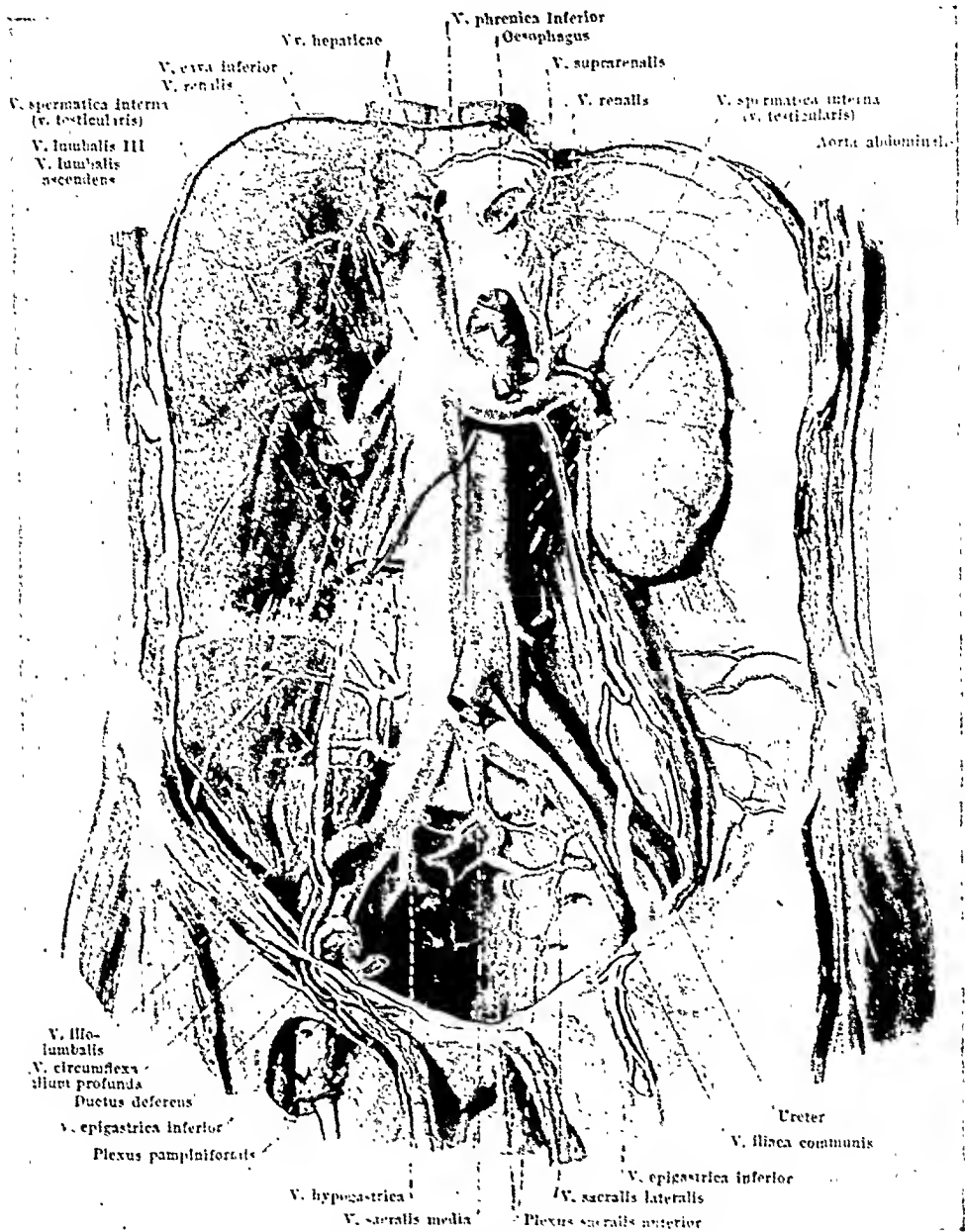


FIG. 165. Gastrointestinal branches of abdominal aorta. (From Spalteholz.)

the twelfth dorsal spine; it is short and wide, running almost horizontally forward for  $\frac{1}{2}$  in. to terminate in its three branches, left gastric, hepatic and the splenic arteries. Of these branches

the gastric is the smallest, the splenic the largest. The superior mesenteric artery arises from the front of the aorta at a point  $\frac{1}{2}$  in. below the origin of the celiac axis (opposite the midepigastric point anteriorly and body of the first lumbar vertebra posteriorly). The inferior mesenteric artery arises approximately halfway between the origin of the superior mesenteric trunk and the aortic bifurcation (i.e. originates about 1 in. above the level of umbilicus) and terminates by becoming the superior hemorrhoidal artery opposite the upper border of the left common iliac trunk, as the arteries cross.

The size of the great abdominal trunks gives some index of the amount of bleeding which would occur from injuries; the celiac axis and superior mesenteric artery are as large as the common carotid; the splenic, hepatic and renal vessels are about the size of the brachial; while the largest part of the inferior mesenteric trunk has dimensions equal to those of the ulnar artery.<sup>236</sup> Complete blockage of the superior mesenteric artery, whether by ligation, embolism or thrombosis is uniformly and promptly followed by extensive hemorrhagic infarction of the intestines and death. The hemorrhagic nature of the infarction is due to venous backflow, the portal venous system being devoid of valves. Anatomically the superior mesenteric is not an end artery, as it is provided with some anastomotic branches with the celiac axis above and the inferior mesenteric artery below; yet it is known as a "functional end-artery" on account of the certain, extensive and severe symptoms which follow its occlusion.<sup>237</sup> While with emboli to small branches of the superior mesenteric artery a relatively small portion of the intestine may be affected, gangrene of the bowel is quite certain and prompt in the involved segment.<sup>236</sup> Humans can tolerate ligation of the common hepatic artery for numerous successful cases have been recorded<sup>238</sup> but following ligation or embolic occlusion there occurs necrosis of large amounts of liver tissue; ligations proximal to the origin of the gastric branches have been unsuccessful. With extensive perihepatic adhesions, marked arteriosclerosis or other conditions

in which collateral circulation is already established, ligation near the origin from the celiac axis might prove feasible. The ability to safely remove the spleen is well-established. In general conditions are better throughout the domain of the celiac axis than elsewhere within the gastrointestinal tract for the establishment of efficient vicarious arterial circulation by way of vessels of the abdominal walls and adjacent viscera.

The chief arteries of the abdominal walls are the superior and inferior epigastrics, the branch of the internal mammary, lower two intercostals, lumbar, and ilio-lumbar arteries, and the circumflex iliac arteries. None of these vessels are normally of great size and they need not be feared by the surgeon in making various incisions through the abdominal parietes since severed trunks are usually readily dealt with by direct clamping and ligation within the wound. The anastomosis of these arteries is sufficiently rich that there is no direct danger in ligations of the vessels.

Surgical management of the abdominal vessels will not be discussed with reference to technical details of the actual ligations themselves (suture materials, clamping, etc.), but only in so far as additional emphasis upon details will serve further to clarify anatomical arrangements within the cavity.

The appendicular artery reaches the appendix by way of the mesoappendix, entering this structure from behind the terminal ileum and taking a course near the free border of the mesenterium. The vessel is ligated during ligation of the mesoappendix (Fig. 166). When the appendix is readily accessible and the operation easy to perform the entire mesoappendix may be ligated en masse, the ligature being first introduced through a rent in the mesenterium near the base of the appendix. When the appendix is long the ligation is best completed by using two or more interlocking knots, each of which encloses but a portion of the mesoappendix. With the latter method the ligature cannot slip. When the mesoappendix is grasped by a single clamp the meson must be almost completely crossed by the blades to secure all tiny branches of the appendicular artery.

In difficult cases it may be necessary to grasp the mesoappendix in several steps by several clamps; here troublesome bleeding is quite certain unless care is taken to sever, at each step,

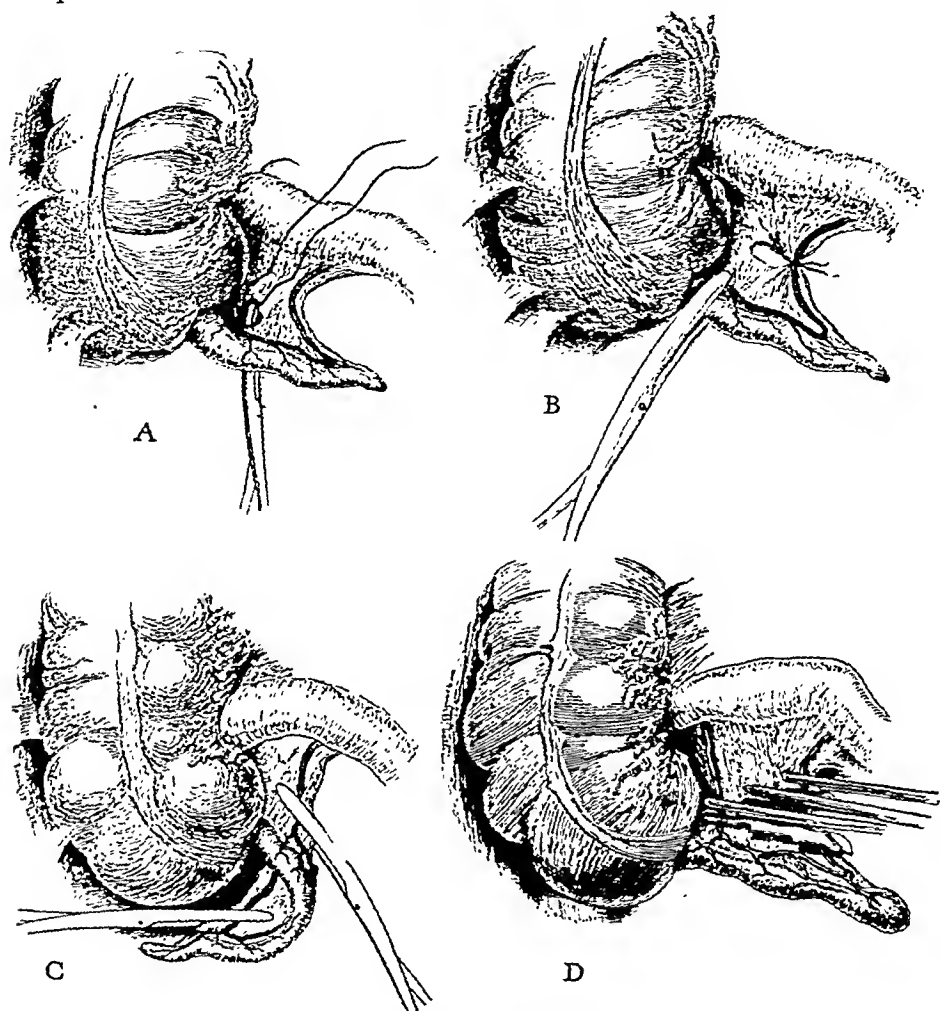


FIG. 166. Ligating arteries of appendix.

- A. Ligating mesoappendix en masse. Note small arterial twig reaching appendix base from cecum.
- B. Appendicular artery ligated. Cecal twig crushed with clamp at base of appendix.
- C. Appendicular artery caught at two points.
- D. Application of several hemostats to mesoappendix.

only so much mesenteriolum as is crushed within the clamp and never to go beyond the crushed portion. Near the base of the

appendix is usually found an additional and separate arterial twig and brisk bleeding is at times encountered when the vessel is cut. Fatal bleeding has been reported from this source. The tiny branch arises from either the anterior or posterior ileocecal artery; and it is the presence at the base of the appendix of this second artery which necessitates the ligation of the appendiceal stump even after it has been crushed and when it is to be inverted. In some instances the main arterial supply of the appendix arises at the base of the organ. Yet as a rule crushing and ligation of the stump take care of the arterial twig (Fig. 166). When bleeding at this point is unusual in amount a separate clamp and ligature may be required, else a backstitch may be taken at the base of the meso-appendix as the inverting pursestring suture is being applied. It is chiefly of anatomical interest that the origin of the appendicular artery (chief trunk) is in dispute. The vessel is variously stated to be a terminal branch of the superior mesenteric artery itself;<sup>239</sup> a terminal branch of the ileocolic artery;<sup>240</sup> a branch of the posterior cecal artery;<sup>241</sup> or at times a twig from either ileocecal artery.<sup>242</sup> The vascular supply of the appendix, like its positions, and like adjacent peritoneal folds and bands, is subject to considerable variation. Practical details concerning the management of unusual cases of appendicitis are reserved for discussion in a chapter dealing with peritoneal reflections and ligamenta variata, where it is the purpose of the section to focus upon minute variations.

Ligation of the main trunk of the ileocolic artery is followed by gangrene of the terminal ileum, cecum, appendix and proximal ascending colon (Fig. 167). The ileocolic artery is liable to injury during attempts to remove tuberculous ileocolic lymph nodes. To sever a small branch may not cause complete death of the parts for the arterial anastomoses are rich, though some of the twigs are end arteries. By cutting only the anterior (right) leaf of the mesentery of the terminal ileum and enucleating the mass bluntly from within a capsule or pseudocapsule, glandular masses may sometimes be suc-

cessfully removed without great damage. Sizable masses, however, should never be attacked in this region unless the surgeon is prepared and willing to perform a complete ileocecal resec-

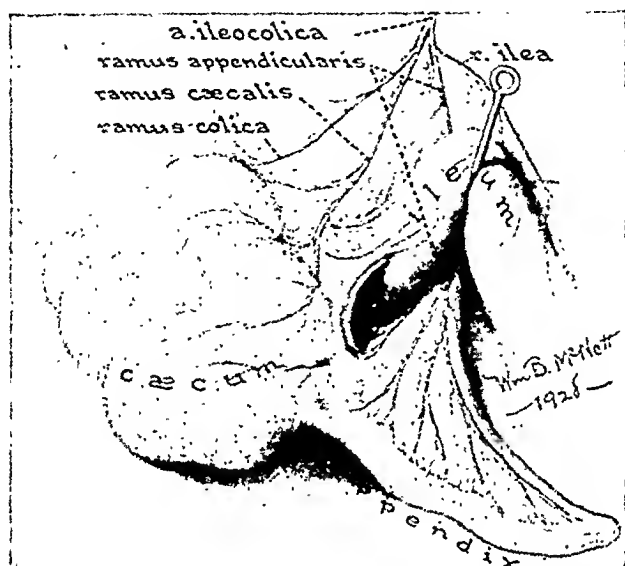


FIG. 167. Blood supply of lower ileum, cecum, and appendix (from Babcock). Ligation of the ileocolic artery, as in the removal of a large mesenteric lymph node is followed by gangrene of the terminal part of the ileum, the appendix, cecum, and first part of the ascending colon. (From Babcock's *A Textbook of Surgery*. W. B. Saunders Co.)

tion with a secondary ileal stoma or ileocolic anastomosis, should the chief vessel (ileocolic artery) be cut.<sup>243</sup>

The gall bladder is supplied with blood by the cystic artery which arises from the hepatic artery itself or its right division and divides into two branches which run on the sides of the gall bladder. The artery or arteries travel alongside the cystic duct and these structures are clamped and ligated together (Fig. 168). Safe and successful clamping is aided by making upward traction upon the neck of the gall bladder, straightening the cystic duct and drawing it away from the common duct and under surface of the liver. The loose connective tissue between duct and liver is bluntly entered and duct and artery together are isolated for from one-half inch to an inch; these are now doubly clamped by means of special biliary right angle

clamps. It is an excellent safeguard to pass an initial stout ligature around cystic duct and artery before these are severed, tying the knot toward the common duct from the clamps and

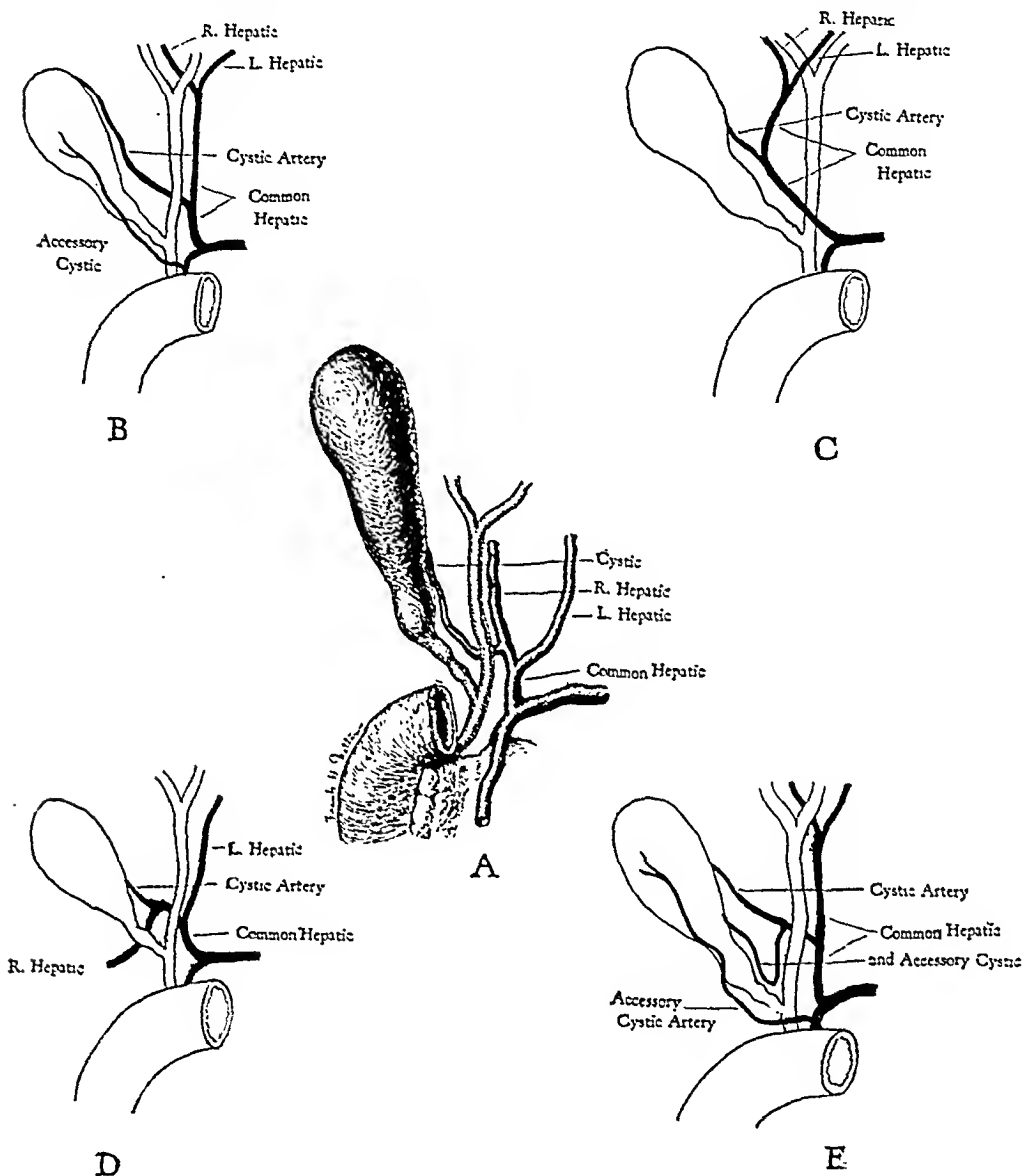


FIG. 168. Arterial supply of gall bladder.

A. Normal arrangement.

B-E. Some of the more common variations. (After Grant Massie.)

loosening the clamp blades as the knot is secured. Duct and artery are now severed between the clamps and the stump again tied. The stump clamp is carefully loosened momentarily



as the first component of the square knot is tied and removed completely as the second component is made fast. As the gall bladder is being removed from below upward oozing may occur from the gall bladder bed. This is quickly controlled by a tampon of hot gauze held firmly against the under surface of the liver. The cut edges of the peritoneal folds beside the cholecystic stump are caught in a suture and the under surface of the liver marking the gall bladder fissure is peritonealized by a running stitch. It is an advantage to leave enough of the gall bladder fundus attached to the under surface of the liver to allow the viscus to be used as a tractor until the oozing bed has been covered with peritoneum. When slight bleeding is persistent a cigarette drain, a roll of rubber dam, or even a Mickulicz tampon may be placed against the under surface of the liver and carried out of the surface wound. In case the cystic artery bleeds it is well to resist the tendency to grasp frantically for the vessel with a clamp, lest the common bile duct be crushed or the portal vein or hepatic artery injured. The vessel may be temporarily controlled by firm pressure with a sponge, or if this fails, by placing the hand in the wound and grasping the stump between thumb and forefinger until the field is made dry and the vessel is safely grasped under full vision. When the initial exposure is adequate and duct and artery are isolated and clamped together as described, and particularly when an initial ligature is applied before the structures are severed, no trouble need be anticipated from severe bleeding. Less common arrangements of the blood supply to the gall bladder are shown in accompanying figures but when outward traction is made upon the neck of the gall bladder while the cystic duct is being exposed all the possible vessels will be safely grasped together as the cystic duct is mobilized and clamped.

During a cholecystostomy little bleeding occurs and any oozing may be controlled by the suture used to hold the drainage tube in position and to invert the cholecystostomy wound. Dangers to the portal vein and hepatic artery during a choledochotomy have been grossly exaggerated. The guide

to the supraduodenal portion of the common bile duct is the foramen of Winslow; for when the finger is inserted into this opening and the free margin of the lesser omentum is

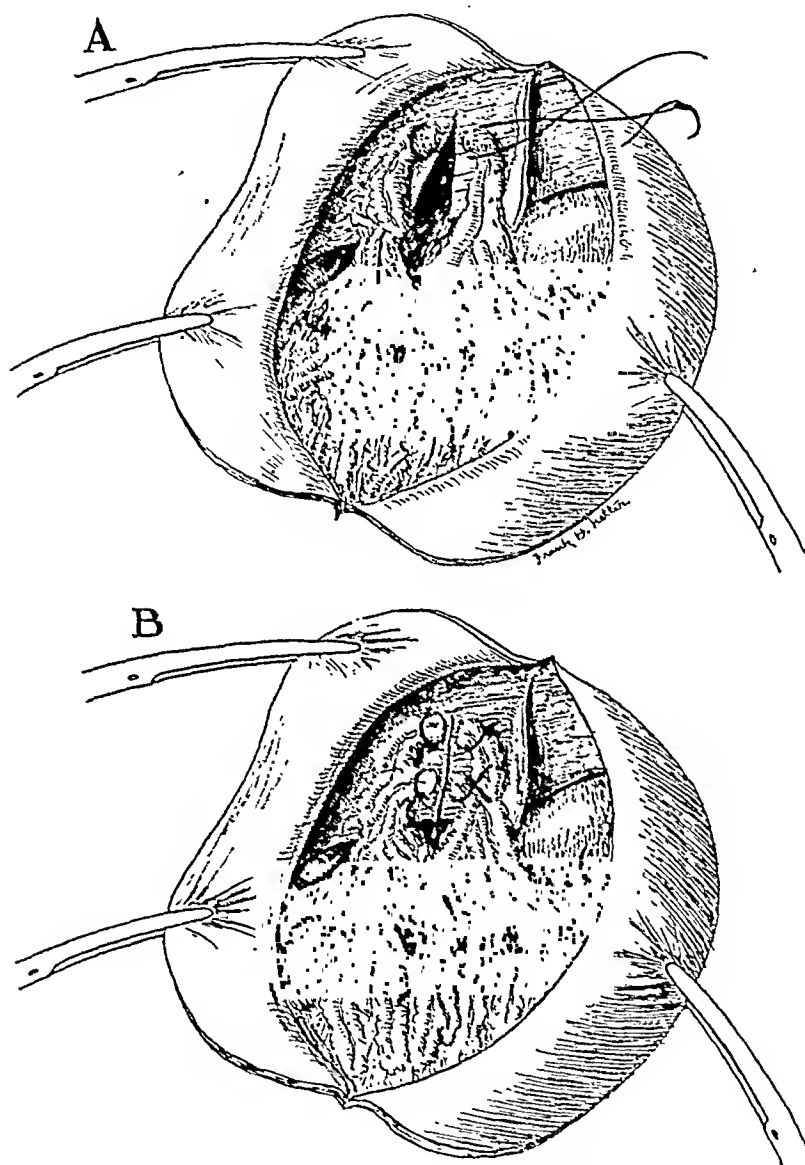


FIG. 169. Bolster sutures for lacerations of liver.

A-B. Use of omentum for bolstering.

hooked forward the common duct invariably comes forward also. The duct may be incised under full vision along its anterior and right side with no fear of injury to important vessels.

The liver bleeds easily and copiously when lacerated, due to its great vascularity and soft structure. Liver bleeding sometimes occurs during the progress of operations upon the gall bladder, biliary duets or stomach. As the gall bladder bed is being peritonealized the liver may be cut by sutures too deeply placed or a retractor, particularly a flat retractor, may accidentally be turned on edge and made to cut into the liver substance. When liver bleeding is severe attempts to control it by means of sutures often result in merely increasing the damage and vascular flow, for as the sutures are tied they tend to cut or tear through the tissue. When one is faced with such difficulties, two surgical dodges may be of aid. The first is to insert the index finger into the foramen of Winslow, hooking up the free margin of the lesser omentum (the hepatoduodenal ligament); by now pressing together the thumb and forefinger it is possible to compress both the portal vein and hepatic artery, and to control the bleeding until the field is dried and the damage is more leisurely repaired. The second is to employ sutures of a mattress type and if necessary to place underpinnings of omentum, rubber strips, or strands of suture material below the external loops of the sutures (Fig. 169). These bolstered sutures will not tear through the liver substance when gently but securely tied. If rubber dam is used for bolstering a free end is, of course, carried through the external wound, where it also acts as a peritoneal drain and may be removed after the sutures have been absorbed. Omentum used for bolstering may be made up of free grafts fashioned for the purpose or of free margin of great omentum turned upward over the liver surface for the purpose. A flat rubber dam sheet may be imposed, in addition, between the margin of the liver wound and the adjacent viscera; or a Mickulicz tamponage may be utilized, the additional thickness serving to give added hemostasis, while on the one side gauze and liver are separated by a rubber layer and upon the other side rubber is interposed between gauze and nearby intestine or stomach.

## EPONYM

## LUDWIG G. COURVOISIER

Courvoisier's Law; a greatly distended gall bladder in case of obstruction in the common duct, speaks in favor of a tumor rather than an impacted calculus.

Ludwig G. Courvoisier. Basel, Switzerland. (Name appears in various sources as Louis G.<sup>1,2</sup> and as Ludwig J.<sup>3</sup>)

Born in 1843. Died April 8, 1918.

Traveled with parents to Island of Malta at age of seven, where he studied natural history and learned the English language.

Returned to Basel to complete early education. Continued special studies in botany and histology.

1865: Won an award for a paper entitled "Histology of the Sympathetic Nervous System." (Age of twenty-two.)

1866. Studied for a semester in Göttingen specializing in pathological anatomy.

1866. Studies interrupted by Prussian-Austrian War.

1867. Returned to Basel to become assistant in surgical clinic under Socin and Bischoff.

1868. Received doctor's degree at Basel; Thesis, "The Microscopic Structure of the Spinal Ganglia."

For following two years assistant to Socin.

Then went to London, becoming friendly with Wood, Fergusson, Thompson, and Spence Wells.

Later, to Vienna, forming friendships with Czerny, and Billroth.

1871. Received appointment as House Physician to a new hospital in Riehen (Diakonissenanstalt). Held position until his death forty-seven years later (1871-1918). Had charge of both medicine and surgery; taught anatomy and nursing to Sisters.

1880. Became connected with University at Basel. Moved to Basel only in 1883, retaining consulting connection at Riehen.

1888. Appointed Associate Professor at Basel.

Twelve years later (1900) offered full professorship upon Socin's death, but refused the honor upon the grounds that a younger man could then best assume the duties of this appointment.

Held many honorary positions in scientific societies.

Casuistisch-Statistische Beiträge zur Pathologie und Chirurgie der Gallenwege. Von Dr. L. G. Courvoisier Leipzig, 1890, pp. 57 and 58. Verlag von F. C. W. Vogel.

Writings many and varied.

Most important work concerned diseases of the gall bladder.

Among published works are the following;

1872. Fall von Addison-Krankheit.

1875. Statistische Beiträge zur Typhusbehandlung.

1877. Eine Gastrostomie.

1883. Behandlung des Empyems der Pleura.

1883. Gastroenterostomie Posterior.

1884. Cholecystotomie und Ectomie.

1887. Ueber Gallensteinoperationen.

1887. Fall von Cholecystomie.

1890. Pathologie und Therapie der Gallenwege.

1891. Chirurgie der Gallenwege.

1896. Zur Diagnostik der Gallensteinkrankheiten.

CASUISTISCH-STATISTISCHE BEITRÄGE  
ZUR  
PATHOLOGIE UND CHIRURGIE  
DER  
GALLENWEGE.

Dr. L. G. COURVOISIER,  
PROFESSOR IN BASEL.



LEIPZIG,  
VERLAG VON F.C.W. VOEGEL.  
1890.

Theile ich sämtliche für diese Untersuchung verwertbaren 187 Fälle in 2 Hauptgruppen, so nämlich ich 57 Stricturen, 130 andre Obstructionen. Wegen ihrer ausserordentlich gleichen anatomischen Bildung lassen sich beide gut vergleichen: Von collidieren mit den Stricturen weichen am häufigsten die Gallenblasenatrophien (20:57 Fälle = 35,1%), viel seltener die Ectasien (17:57 = 29,8%). Die andern Verhältnisse dagegen treten viel seltener mit Atrophie (2:187, viel häufiger mit Ectasie (22:100) zusammen. Oder anders ausgedrückt: Bei Stricturen ist die Gallenblase atrophisch, bei Ectasie ist Ectasie der Gallenblase selten; das Organ ist vorher schon gewöhnlich geschrumpft. Bei Obstructionen andrer Art ist dagegen Ectasie der Gallenblase, Atrophie besteht nur in 1%, d. h. in 2 Fällen.

Dieses Ergebnis der Untersuchung ist mir überraschend genug gewesen. Gewöhnlich wird in den Hand- und Lehrbüchern angegeben, Stricturen des Choledoctus führe durch Gallenstauung zu Gallenblasenvergrößerung. Ich finde das gerade Gegenteil und muss das Fehlen einer Ectasie bei Verengung des Ganges geradezu als charakteristisch für Stein, für Verkalkung als herrschend für sonstige Occlusion betrachten. Wenn sich das noch weiter bestätigen sollte, so wäre damit ein wichtiger Anhaltspunkt für die differentialdiagnostische Diagnose gewonnen.

Ich habe übrigens auch auf eine andre Art versucht zu ermitteln, ob die eben erwähnte Differenz im Verhalten der Gallenblase wirklich besteht und in wieviel sich zu erkennen gebe. Unter den in meinen Tabellen aufgeführten Operationsfällen finde ich 15 mit Choledochstricturen, darunter 17 durch Steine, 16 durch Stricturen, Druck von Tumoren u. s. w. Von diesen auf jene 17 nur 4, auf jene 16 aber 10 mit Ectasie, auf jene 17 dagegen 12, auf diese 15 nur 2 ohne Vergrößerung der Gallenblase. — Von den 29 Ectasien betreffen nur 1 Stricturen, 16 andre Verengungen. Dies ist also ein noch schärferer Unterschied, als ich ihn bei der ersten Untersuchung constatirt hatte.

Uebrigens ist die Erklärung für diesen Unterschied nicht schwierig. Laut früherer Darstellung (p. 17) stammen die Choledochsteine in der Regel aus der Gallenblase. Auf ihrem Weg aber haben sie, wie oben dort gesagt worden ist, den Cysticus und zum Theil die Blase gereizt und in beiden deutliche Spuren eines entzündeten Durchtritts in Form einer chronischen Entzündung der Wandung hinterlassen, welche häufig selbst zur Schrumpfung jener Behälter führt. Ist nun die Gallenblase so verkrüppelt, so wird auch die stärkste Gallenstauung sie nicht mehr ausdehnen können. Bei den meisten andern Obstructionen, speciell bei denjenigen durch druckende Geschwülste, findet die niedrigere Galle eine normale, ausgiebige Blase vor:

FIG. 170.

1899. Uebersicht über Meine Gallensteinoperationen.

1903. Behandlung der Cholelithiasis.

1913. Eine Basler Gallensteinstatistik.

Courvoisier did not present his law or sign as being absolute; he presented exact figures, however, to substantiate its reliability. He found marked dilatation of the gall bladder in 92 of 100 cases of common duct obstruction due to causes other than blockage by stones. (Atrophy occurred in but one-twelfth of such cases.) Courvoisier found marked atrophy of the gall bladder in over 80 per cent of cases of common duct blockage from stones.

Courvoisier's participation in the Franco-Prussian war of 1870 gave him great opportunity to carry out his studies in surgery.

Unexpected appointment at Riehen immediately after this war enabled him to marry and found his home (age of twenty-eight).

Contracted severe blood poisoning while at Riehen and wrote one of his books during his convalescence.

Courvoisier's work was never brilliant but he was most methodical and thorough. He became very well known and was in great demand as a consultant.

Courvoisier was extremely modest with reference to professional honors. This attribute kept him from many positions which he might rightfully have held. His refusal of the full professorship at Basel in favor of a younger man well illustrated his viewpoint.

He was in touch with all branches of civic work and played an important rôle in community public health.

He founded a savings fund for the sick in the form of insurance with benefits over periods of illness.

Courvoisier throughout his life was a naturalist and upon his death his remarkable collection of butterflies was presented to the museum at Basel.

Courvoisier lived through the periods of sepsis, antiseptis and asepsis and credited his predecessor and surgical chief Socin, who did much to advance his surgical fortunes, for doing in Basel what Lister has done in Edinburgh to advance antiseptic methods. Courvoisier wrote: "Surgery lay at that time (1866) in the septic period as one may call it, in a very bad state. Scarcely a wound healed primarily, they all suppurated whether they were already infected outside of the hospital or whether due to a well prepared operation in the hospital. But Socin was already at that time clear in his mind that suppuration, wound fever, pyæmia, erysipelas, could be due only to infection from without, and with the clear vision of genius as one of the first on the continent, he introduced the method of wound treatment, as yet only in its incipency, in the same manner as the Scotchman Lister had sought to do and had developed in Edinburgh in his clinic; and it was my privilege to witness all the phases passed through by the new carbolic therapy. The success achieved with this treatment was remarkable, although not to be compared with the later antiseptic or the aseptic method which in turn replaced the former."

1. Stedman's Medical Dictionary, Ed. 8.

2. Dorland's Dictionary.

3. Gould's Dictionary.

4. Index Medicus Surgeon General's Office.

5. Oblituary: E. Veillon. *Correspondence Blatt f. Schweiz. Aerzte*, 73: No. 39, 1319, 1918.

## STATISTICAL REPORT OF CASES RELATING TO PATHOLOGY AND SURGERY OF BILIARY DUCTS

DR. L. G. COURVOISIER

(Translated from the German)

If I divide the 187 cases which were studied in this investigation into two chief groups, then I obtain 87 cases as being the result of obstruction by stones, and 100 cases as being due to some other form of obstruction. These two groups because of the similar number of cases they contain can be well compared with each other.

Now the cases of obstruction by stones coincide most frequently with the atrophies of the gall bladder (70:87 cases = 80.4 per cent) much more rarely with the ectasia (17:87 = 19.6 per cent). The other types of obstruction on the other hand, coincide much more rarely with atrophy (8:100), much more frequently with ectasia (92:100). Expressed in other words: In cases of obstruction of the ductus choledochus by stones, ectasia of the gall bladder is rarely present, this organ being usually shrunken already before obstruction took place. In other forms of obstruction on the other hand, ectasia is usually present, atrophy being found only in one-twelfth of these cases.

This result of our investigation was very astonishing to me. It is generally stated in handbooks and textbooks that obstruction of the ductus choledochus by stones leads to stasis of bile and dilatation of the gall bladder. I find the exact contrary and must regard the absence of ectasia in cases of obstruction of the ducts as being actually characteristic of obstruction by stones, its presence as indicative of other forms of occlusion. If this is found to be still further corroborated, then we will have gained thereby an important fact in the differential diagnosis.

I have besides attempted to learn in a different way whether the above discussed difference in the behavior of the gall bladder actually exists and whether it lends itself to recognition in practice. Of the operative cases enumerated in my tables, I find 35 with obstruction of the ductus choledochus, of which 17 were caused by stones and 18 through strictures, pressure of tumors, etc. Now, of those 17 cases, only 4 showed ectasia, whereas of those 18 cases 16 showed ectasia. Of those 17, on the other hand, 13 do not show any enlargement of the gall bladder, and of those 18 cases, only 2 showed no enlargement of this organ; of these 20 ectasias, only 4 were due to obstruction by stones, and 16 were due to other types of obstruction. This is a still sharper difference and has been demonstrated in our first investigation.

Moreover, the explanation of this difference is not difficult. According to previous views, stones in the ductus choledochus were said to originate as a rule in the gall bladder. On their way, however, as has been shown above, they have irritated the cystic duct and in part also the gall bladder, and have left in both of them distinct signs of a forced pathway, namely in the form of a chronic inflammation of the wall. This chronic inflammation often leads ultimately to contraction of that reservoir. Once the gall bladder has become so altered, then even the severest obstruction to the outflow of bile will no longer suffice to distend the bladder. In most of the other forms of obstruction, especially those brought about by pressure of tumors, the dammed-back bile finds a normal elastic gall bladder.

## QUESTIONNAIRE

1. How do veins give clinical evidence of intra-abdominal disorders?
2. Why are the diagnostic leads afforded by veins of particular value?
3. What signs are produced by obstruction of an external iliac vein?

4. Describe in detail the changes in the lower extremity from obstruction to its venous blood current.
5. What is the abdominal phase of the clinical picture of iliac vein obstruction?
6. With venous stasis in a lower extremity why is the part cool; why dusky color; why sometimes pale; at what part of the limb is edema most marked and why?
7. Distinguish the edema of venous stasis from that of lymphatic stasis.
8. What are the three uppermost tributaries of the long saphenous vein?
9. What intra-abdominal conditions are suggested by engorgement of the right superficial circumflex iliac vein?
10. In what ways does the clinical picture of common iliac vein obstruction differ from that of iliac vein obstruction?
11. What are the possible urinary findings with marked engorgement of the vesicle venous plexus?
12. Name the points of anastomosis of vessels of the portal with those of the systemic venous system.
13. What is the relation between the obturator nerve and the common iliac vein?
14. What are the venous tributaries of the hypogastric vein?
15. What is the clinical picture of blockage of the inferior vena cava?
16. What is meant by caval collateral veins; by portal collateral veins?
17. What are the urinary and clinical findings with stasis within the renal veins?
18. How can these be distinguished from evidences of true nephritis?
19. How can the direction of the blood current within a vein be determined?
20. What is the normal direction of current within the superficial epigastric vein?
21. Describe the rerouting of blood with complete obstruction of the inferior vena cava. Name vessels involved.
22. What is the direction of blood flow within dilated veins upon the anterior abdominal wall caused by mediastinal tumors obstructing the superior vena cava?
23. How do venous clinical evidences of superior caval obstruction differ from those of inferior caval obstruction?
24. Classify causes of obstruction to the inferior vena cava.
25. Discuss differentiation of the various causes of inferior vena caval obstruction?
26. What is the clinical picture produced by obstructions of the portal vein?
27. Explain the differences between hematemesis and cirrhosis of the liver.
28. What is the caput Medusae; name the veins involved, efferent and afferent vessels; what is the direction of the venous flow?
29. What is the most common cause of obstruction of the portal vein?
30. Name or classify causes of portal obstruction; discuss these as to their relative frequency.
31. What are the probable points of lodgement of emboli originating from common iliac vein, ileocolic vein, saphenous vein, renal vein, superior mesenteric vein?
32. What are the more common causes of pulmonary embolism, of pyelephlebitis?
33. Upon which side of the chest are evidences of pulmonary embolism most likely to be discovered?
34. What are the symptoms of a pulmonary embolus; roentgenographic findings?
35. What is the incidence of postoperative thrombosis?
36. What is the postoperative incidence of embolic phenomena?
37. Name some of the factors within the control of the surgeon which most surely decrease the incidence of postoperative thrombosis.
38. What is the most common cause of vulval varices; other causes?
39. How frequent are phlebectasiae during pregnancy? How frequently do marked varicosities occur?



40. What are the common sites of varicosities due to pregnancy; to what are these varicosities due?
41. What percentage of varicoceles are bilateral; what percentage occur upon the left side; what upon the right?
42. What is a symptomatic varicocele?
43. Explain why varicoceles are more common on the left than on the right side.
44. What are the more common causes of a symptomatic varicocele?
45. Upon what grounds may a femoral hernia be differentiated from a saphenous varix?
46. Name some of the typical signs that serve to identify a saphenous varix.
47. What is a direct hernia?
48. Give the origin and course of the deep epigastric artery.
49. Between what layers of the abdominal wall does it travel?
50. Bound Hesselbach's triangle.
51. What are the inguinal peritoneal fossae? How many? How formed? Location?
52. Describe the femoral artery test for hypogastric peritonitis. Discuss this test.
53. Describe the detection of expansile pulsation in an aneurysm of the abdominal aorta.
54. What is dermatographism? What is meant by metamerism?
55. What is meant by the "red cross" vasomotor sign?
56. Define hematemesis, coffee-ground vomiting, melena, occult blood.
57. From what other points besides the stomach may vomited blood arise?
58. Discuss hematemesis with peptic ulcer; with cirrhosis of the liver.
59. From what other gastric diseases beside ulcer may hematemesis arise?
60. Discuss hematemesis with gastric cancer; with leucemias.
61. How many hematemesis and hemoptysis be distinguished?
62. What is the probable source of melena?
63. What are the probable sources of bright red blood passed by rectum?
64. What is the significance of occult blood? What are the tests for occult blood?
65. When blood is passed per anum what is the significance of blood mixed with pus, blood mixed with the motions; blood streaking the motions?
66. What is the character of the blood by rectum and of associated signs and symptoms with intussusception; mucous colitis; typhoid fever; tuberculous ulcer; mesenteric thrombosis; purpura hemorrhagica; hemophilia; rectal polyp; cancer of the sigmoid?
67. What is the typical anal discharge with cancer of the rectum or rectosigmoid? How is a positive diagnosis to be established?
68. Name some medical conditions which most commonly simulate surgical conditions of the abdomen.
69. Differentiate chronic passive congestion of liver from cholecystitis.
70. Differentiate Henoch's purpura from acute appendicitis.
71. Differentiate angioneurotic edema involving intestine from mechanical obstruction of the bowel.
72. Explain the basis of abdominal pains or vomiting with tabes dorsalis, plumbism, brain tumor, angina abdominalis.
73. What methods may the surgeon adopt to protect his patients from needless operations when non-surgical conditions produce symptoms simulating surgical diseases of the abdomen?
74. What are the branches of the abdominal aorta?
75. What arterial trunks supply the abdominal portion of the gastrointestinal tract?
76. Can humans tolerate the ligation of the following; superior mesenteric artery? the hepatic artery? the splenic artery?
77. Name the arteries supplying blood to the abdominal walls.

78. Describe the blood supply of the appendix.
79. Describe in detail the control of bleeding during an appendectomy.
80. What is the origin of the appendicular artery?
81. Does the appendix receive arterial blood from any source beside the appendicular artery?
82. What is the effect of ligation of the ileocolic artery?
83. Describe the normal blood supply of the gall bladder.
84. Describe abnormal arrangements of blood vessels to gall bladder.
85. Describe control of bleeding during cholecystectomy; during a choledochotomy?
86. Describe control of free bleeding from the liver. What are bolstered sutures?

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## A NEW METHOD OF BLOOD VESSEL VISUALIZATION (ARTERIOGRAPHY; VEINOGRAPHY; ANGIOGRAPHY) IN VIVO\*

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THE study of the roentgenological visualization of the vascular system in the living was first reported in 1898. In that year Podres by accident observed roentgenologically a shot which was floating in the heart of a patient following a heart injury. Shortly after, Trendelenburg, Riethus, Haecker, Revenstorf and others studied roentgenologically the pathology of the heart after injection with various opaque substances. Before these experiments aneurysms and sclerosed arteries had already been seen. The first one, however, who undertook the systematic experimental work by means of the opaque substances in order to determine whether or not visualization of vessels was possible in living subjects, was Sehepeltmann. He used the various heavy metal compounds and the oil suspension, but he did not get good results in visualizing the small vessels.

Thereafter, it was found that collargol, quicksilver, bismuth-oil-suspension, bromine or iodic compound, tetraiodophenolphthalein, calcium lacticum, calcium iodatum, calcium chloratum, "Dominal X," iodized oil and iron chloride all gave unsatisfactory roentgenologic films in human beings and animals.

At present, the bromine and iodic compounds are usually used for arteriography. However, with these compounds dangerous results follow occasionally after intra-

arterial injection. For instance, Berberich and Alvens reported the possible danger of embolism in arteriography. "Dominal X," although sold in Germany as an arteriographic medium, was not generally used. Moniz, Carbonnel, Duval, Brooks and others found that there was severe pain during the period the solution remained in the artery, and therefore the patient could not be kept still enough to get a good roentgenogram unless a general anesthetic was used. Carbonnel and Masse reported 3 cases of localized gangrene of the toes in which arteriography after the intra-arterial injection of a sodium iodide solution had given a different result in each case. In one case the clinical picture became one of simple gangrene; in the second case, more precise indications were obtained with arteriography than with any other method of clinical examination; and in the third case arteriography gave a wrong indication. Thus the results of arteriography after the intra-arterial injection of sodium iodide solutions are not more reliable than the results of other clinical methods of examination. Furthermore, Duval noted the occurrence of more or less grave accidents during the intra-arterial injection of sodium iodide: i.e., extension of gangrene, and severe pain, with vascular spasm followed by vascular dilatation of the leg and general symptoms of iodine poisoning, death within two days

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after the injection. He concluded that the idea of obtaining a radiogram of the vascular system in vivo is very tempting, but because of the frequent occurrence of accidents and the unreliability of results in arteriography with sodium iodide as compared with the other less dangerous methods of clinical examination, he would hesitate to experiment with this method. The further development of this method of arteriography was therefore interrupted.

The writers, after extensive experimental injections into the internal carotid artery of dogs and rabbits with various solutions, found that 20 to 30 per cent solution of sodium bromide is less dangerous than other bromic or iodic compounds. It is possible to inject into the internal carotid artery in the proportion of 1 c.c. per 1 kg. of the weight of the animal. Even in these cases, however severe local irritation of the vessels and dangerous reactions were observed following injection.

Therefore, in order to get rid of these troublesome reactions various solutions were tried: i.e., gummi arabicum, dextrose, salt and gelatine were added to the solution injected. None of these proved satisfactory. It was also proved that collargol, electrargol, tetraiodophenolphthalein, tetrachlorophenolphthalein and thoriumdioxhydrocol were all ineffective.

Years ago, it was known that oil and its emulsion could be injected into the vascular system. For instance, Neumann, Kreidl, Lindenberg and Rangel, Cartier and Fischer used various oils or their emulsions for the purpose of treatment and nourishment. But the first one who tried arteriography using oil was Schepelmann. He injected oil itself but without success. Shortly after, Frank and Alwens injected bismuth-oil-suspension, prepared by Richter, into the heart, but did not get good results in the arteries. Sicard, Baillat and his co-workers, Carnett and Greenbaum and Frazier, selected the iodized oil itself for intra-arterial injection in order to visualize the cerebral arteries and arteries of the extremities. But this oil

could not be injected into the vascular system in a large enough amount to get a good arteriogram, because of the danger of oil embolism. Therefore the study of arteriography using the iodized oil itself was discontinued and is usually not mentioned in present-day literature.

It was thought by the author that if iodized oil could be so prepared as to be injected intra-arterially without dangerous reactions it would be preferable since it has no local irritating effect and is a stable chemical compound not capable of osmosis.

Working on this theory we finally succeeded in visualizing the vascular system without any reaction or danger. A fine emulsion of iodized oil newly prepared consisting of a colloidal solution was used.

At first the emulsion of the iodized oil, using the glycerin, alcohol, gummi arabicum and lecithin, was employed but without good results. At this time Prof. Dr. Yamakawa, Tohoku Imperial University, had made "yanol." This is a fine emulsion of the oil given intravenously for the purpose of nourishment. However, yanol and iodized oil emulsion as an arteriographic medium differ considerably. Yanol has a much lower percentage of oil and a lower specific gravity. After further experiments a fine emulsion of iodized oil was prepared. This may be injected intra-arterially for arteriography with perfect safety. To prepare it the "protalbin-albumin-acid" (an emulsifier originated by Prof. Dr. Hattori, Tokio Imperial University) was used, with the assistance of Dr. Yanagizawa, the chief apothecary of our university.

This new contrast medium for arteriography was named "L'ombre." This preparation is a yellowish-white, slightly alkaline isotonic emulsion. It has no hemolytic or rapid hemostatic action in vivo or in vitro. Each oil globule is smaller than a blood corpuscle. As is known, if the fat is taken as a meal it is emulsified or subdivided into minute particles of microscopic size in the intestine by the action of the digestive juices. The emulsified fat enters the

lymph-capillary in the interior of the villus, thence passes into the thoracic duct and finally into the blood circulation. Therefore the intra-arterial injection of this emulsion is physiological.

Preliminary experiments were performed on dogs. Under local anesthesia, an incision was made on the left side of the neck and the common carotid artery as well as the external and internal carotid artery were exposed. For the purpose of testing the safety of the procedure, the needle attached to a syringe was introduced into the artery and a small amount of blood withdrawn into the emulsion, and reinjected into the artery. The films were taken at the end of or immediately after the injection. The following conclusions were reached: (1) there were no local irritating effects; (2) no emboli; (3) no severe general reaction. Histological observations during the succeeding three weeks were made, and no pathological changes such as fat embolism, atrophy or malacia in the brain or changes in the vessel walls were found.

#### METHODS OF PREPARATION ATTEMPTED

*Present Technic:* Lipiodol descendant (25 c.c.) is thoroughly mixed with lecithin (10 gr.) and protalbinaeid (0.75 gr.) in a glass mortar. Five per cent solution of glucose is then added gradually by stirring until the total amount becomes 100 c.c. Now a stable fine emulsion of iodized oil is obtained.

Or in a glass mortar, lipiodol descendant (25 c.c.) and lecithin (10 gr.) are thoroughly mixed with honey (10 gr.). Distilled water is then added little by little, mixing well by stirring, until the total amount becomes 100 c.c. Naturally all glass and instruments used must be aseptic. The newly prepared emulsion must be kept in ampules or protected from contamination by other means.

These emulsions were named as follows according to the emulsifier in them.

Old lipiodol emulsion, in which only lecithin is contained.

L'ombre A (alcohol)

L'ombre G (glycerin)

L'ombre P (protein-albumin-acid)

L'ombre E (the white of an egg)

L'ombre H (honey)

#### TECHNIC FOR ARTERIOGRAPHY

Arteriography can be performed by injecting the artery without incising the skin, but this is sometimes very difficult. Therefore a small incision is made and the artery exposed. The needle is introduced into the trunk of the artery or better into a small branch of the artery after temporary ligation of the trunk with a vessel clamp. The technic of arteriography can thus be divided into two types, i.e.,

1. Percutaneous injection and
2. Incision method.
  - a. Puncture of the trunk of the artery.
  - b. Puncture of the small branch of the arterial trunk (our method).

1. PERCUTANEOUS INJECTION. The technic of injection, according to Hirsch, into the common carotid artery without incising the skin is as follows: a needle is attached to a syringe containing the quantity of drug to be administered. The syringe is held in the hand like a writing pen, touching the skin almost perpendicularly, and not in the usual way when injecting intravenously. This position facilitates making a direct puncture and obviates the possibility of raising the outer coat of the artery. In this perpendicular position the needle has less chance of striking the internal jugular vein, which frequently overlaps the artery. The index and middle fingers of the left hand palpate the pulsation of the artery and the needle is directed toward the pulsation. The puncture is best made near the anterior edge of the sternomastoid muscle and near the upper border of the omohyoid, and just below the level of the upper border of the thyroid cartilage. When the needle reaches the level of the sheath of the large vessels, there is a definite resistance to further progress even if the needle is very sharp. This resistance is discernible



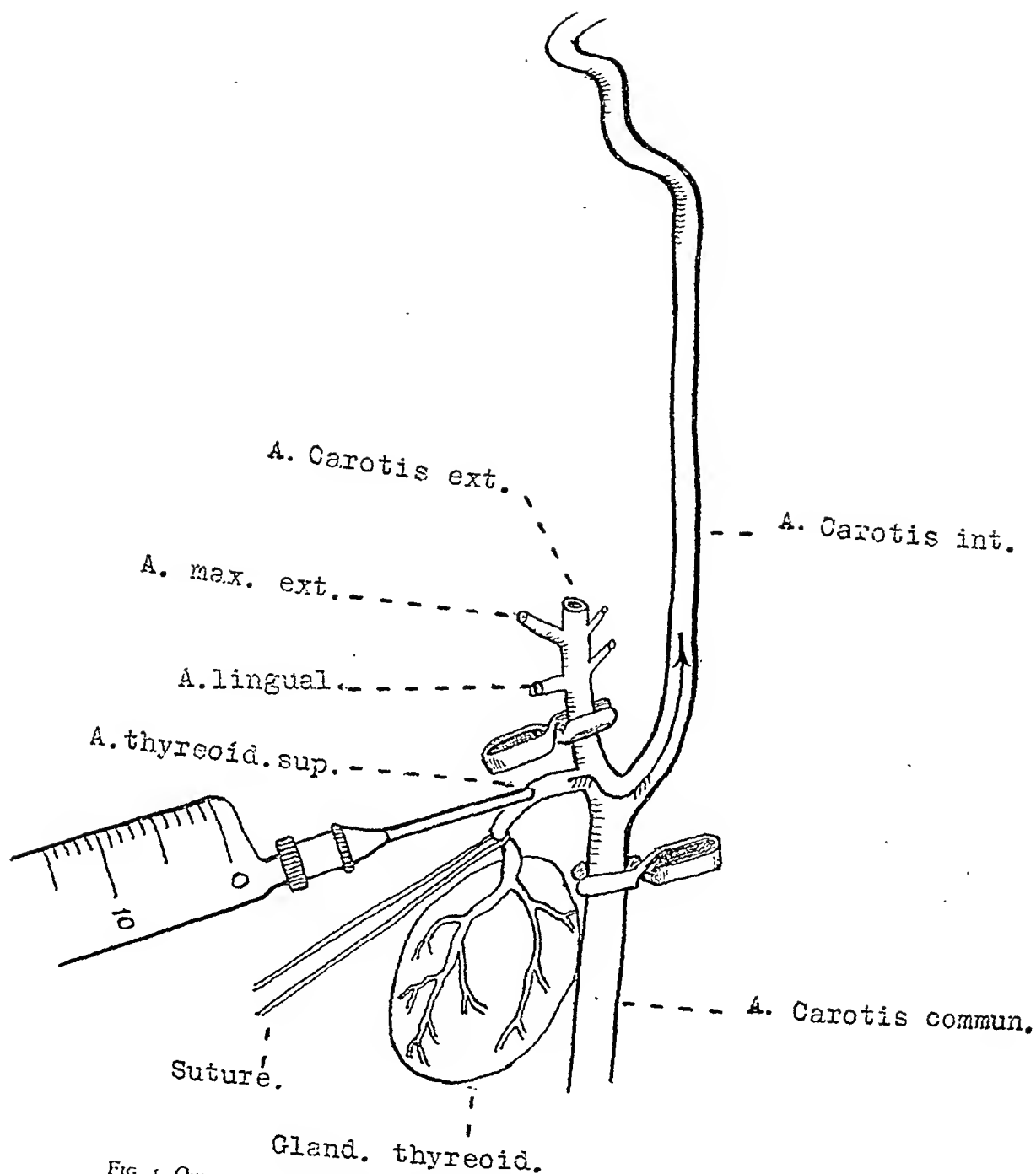


FIG. 1. Our own new modified technic of injection of L'ombre into internal carotid artery.



FIG. 2. Case 1. Genuine epilepsy. Arterial encephalography by injection of L'ombre through superior thyroid artery. Roentgenogram shows all cerebral arteries normal.



FIG. 3. Case 11. Tumor of anterior lobe of cerebrum on right side. Arterial encephalography, L'ombre injected through superior thyroid artery.

I, Ascending part of internal carotid artery. II, Internal carotid artery in earotid canal of temporal bone. III, Internal carotid artery at internal base of skull. AC, chorioid artery. S, middle cerebral artery, in abnormal course, displaceed downward and backward at Sylvian fossa, showing that tumor was situated in and coursed deeply into anterior lobe of cerebrum. A, anterior cerebral artery, in normal course, showing that tumor was not situated in and did not involve opposite side of hemisphere over horizontal fissure of cerebrum. AO, ophthalmic artery. V, lateral ventricle, depressed downward by tumor. In part of ventricle is seen small amount of gas which was infused for pneumoventriculography on preeeding day. T, Tumor.

after a little practice and is of great value because at this moment downward pressure must be stopped and the needle

discussing this method and also remarked regarding intra-arterial injection of the vertebral artery.

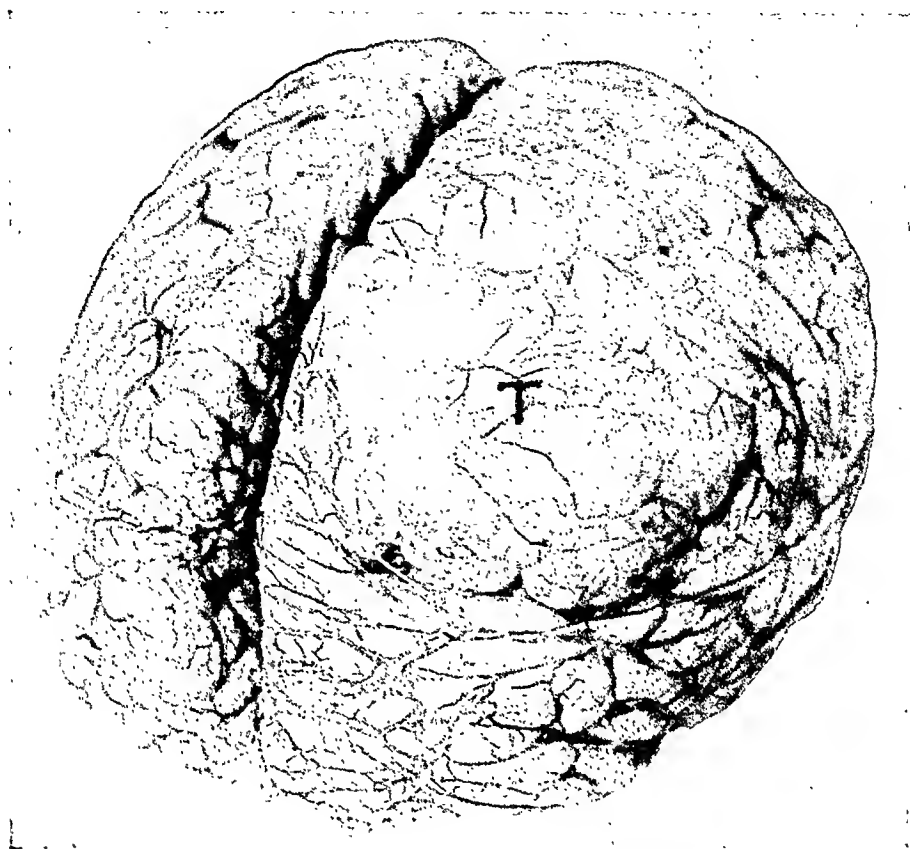


FIG. 4. Brain of same patient.

inserted into the artery by very gentle manipulation. Continued great pressure at this point will flatten the artery because of density of the sheath, and the needle will cut through both the anterior and posterior walls of the artery. Inclusion is then best effected by gently withdrawing the needle, and the injection is not begun until the blood is seen spurting into the syringe with each pulsation of the artery. The spurting of blood is also the index of proper inclusion of the needle on its downward course. The pulsation into the syringe is not visible if a needle of small caliber is used and it is preferable to use one of fairly large caliber. In nervous patients this procedure must be done with a general narcosis or before operation a sedative is given.

Thereafter, Enderlen published the method of intra-arterial injection in detail,

Moniz first used this method on human beings for arterial encephalography.

The technic of injection for arteriography of the extremities is as follows: as in Bier's intravenous anesthesia or Goyanes's intra-arterial anesthesia, the part of the extremity for examination is prepared for operation. The two rubber constrictors are placed around the part of the extremity above and another below the field where the arteriography is performed. But they are not tightened. The needle is attached to the syringe containing the L'ombre to be administered. The syringe is held in the right hand. The index and middle fingers of the left hand palpate the pulsation of the artery and the needle is directed toward the pulsation. Under infiltration anesthesia or without it, a needle is inserted into the artery immediately below the proximal rubber tourni-

quet. After proper inclusion of the needle into the artery, spurting of blood into the syringe will be seen. The proximal tourni-



FIG. 5. Case III. Fracture of humerus. L'ombre injected into upper ulnar collateral artery. X-ray shows radial and brachial arteries amputated at elbow, arterial nets newly proliferated at under border of elbow but no arteries to periphery. AB, brachial artery. A, amputation of artery. CI, common interosseous artery. G, newly proliferated arterial nets.

quet is now tightened enough to close the artery at that point. After a short interval the distal rubber tourniquet is tightened, then a certain quantity of solution is injected toward the periphery, enough to fill the artery between the two tourniquets. At the end of the injection the roentgen-ray tube is then operated for the briefest period possible to secure a good film. The distal tourniquet is first released and the needle is withdrawn. At the completion of the operation the proximal tourniquet is removed gradually to prevent rapid diffusion of the solution. On the small puncture wound of the needle a small adhesive plaster is applied.

According to this method, arteriography of the part indicated is done with a small amount of the contrast medium. Instead of using a blood pressure arm band, Sehrt's tourniquet, Zwirn's tourniquet, an Esmarch bandage may be used; but we think the blood pressure arm band is the best.

This technic of arteriography by a percutaneous puncture of the artery is used on arteries such as the femoral or branchial which run superficially. But if the tightening of the proximal tourniquet is insufficient the result is indefinite; therefore, for arterio-encephalography this method is not suitable.

2. INCISION METHOD: *a. Puncture of the Trunk of the Artery.* With a local anesthesia of 0.2 per cent tutocaine solution the artery is exposed to permit the application of the arterial clamp. The trunk of the artery is closed by the clamp and punctured immediately below the clamp. Then the injection is begun and the roentgen-ray film record is made. Moniz used Knauer's method for arterio-encephalography but he later noted that the temporary ligation of the external carotid artery was needed even in an incision method.

*b. Puncture of the Small Branch of the Trunk.* This is our own method. When the exposure of the arterial trunk is difficult or impossible due to various pathological conditions this method is most effective.

Some objection might also be raised to puncturing the large vessels. The method of exposure of the artery with a local anesthetic is the same as previously described. The trunk of the artery is closed by the arterial clamp, and after selecting for injection a small branch coming from the trunk distal to the clamp, it is punctured. This method is especially convenient and useful for arterial encephalography.

In *arterial encephalography*, a temporary ligation of the external carotid artery is necessary. An injecting needle with a fairly large caliber should be used and the injection made rapidly because the solution may be diluted at the base of the skull by the blood stream from the opposite side. The puncture of the trunk by a needle with too large a caliber might be followed by bleeding after withdrawal. Also there is a possibility of thrombosis of the artery resulting from later pathological changes of the arterial wall. It is also impossible of performance in a patient with arteriosclerosis.

This method has changed as follows: A small incision, with the center at the great cornu of the hyoid bone, is made on the side of the neck along the anterior edge of the sternomastoid muscle; and without injuring even a small vessel, the common carotid, the external carotid and the internal carotid are exposed. Furthermore, the superior thyroid artery arising from the external carotid close to its origin is exposed. The superior thyroid is then drawn outward with a bit of suture, care being taken to avoid the superior thyroid veins and the superior laryngeal nerve. The external carotid and the common carotid are then clamped off by using a Carrel hemostat. The superior thyroid is drawn forward with the aid of a suture around the artery. After insertion of a fairly large caliber needle into the superior thyroid artery, a certain amount of L'ombre is rapidly injected. During the final part of the injection, a very rapid stereoscopic roentgenogram of the skull is secured. Or, a film may be exposed at the end of or immediately after the injection;

in other words, the roentgen-ray exposure and injection are over at the same time. Immediately following the exposure the



FIG. 6. Case iv. Buerger's disease. L'ombre injected through external pudendal artery. X-ray shows popliteal artery completely obliterated and only small arteries running into leg. AGS, arteria genu suprema. O, obliteration of popliteal artery.

clamp which tightened the external carotid is released and then the clamp on the common carotid is removed gradually. If the bleeding from the puncture wound on the superior thyroid is great, the ligation of this vessel is easy.

This method for arterial encephalography is superior for the following reasons: (a) no injury to the common carotid; (b) the possibility of injection by a needle with a large caliber, (c) possibility of



FIG. 7. Case v. Aneurysm. L'ombre injected through superficial temporal artery. Arteriogram shows traumatic aneurysm.

repeated punctures, two or three times, without much bleeding, (d) and of performance in patients with arteriosclerosis.

the size of the part to be injected. In arterial encephalography the quantity averages from 5 to 7 c.c., but by means

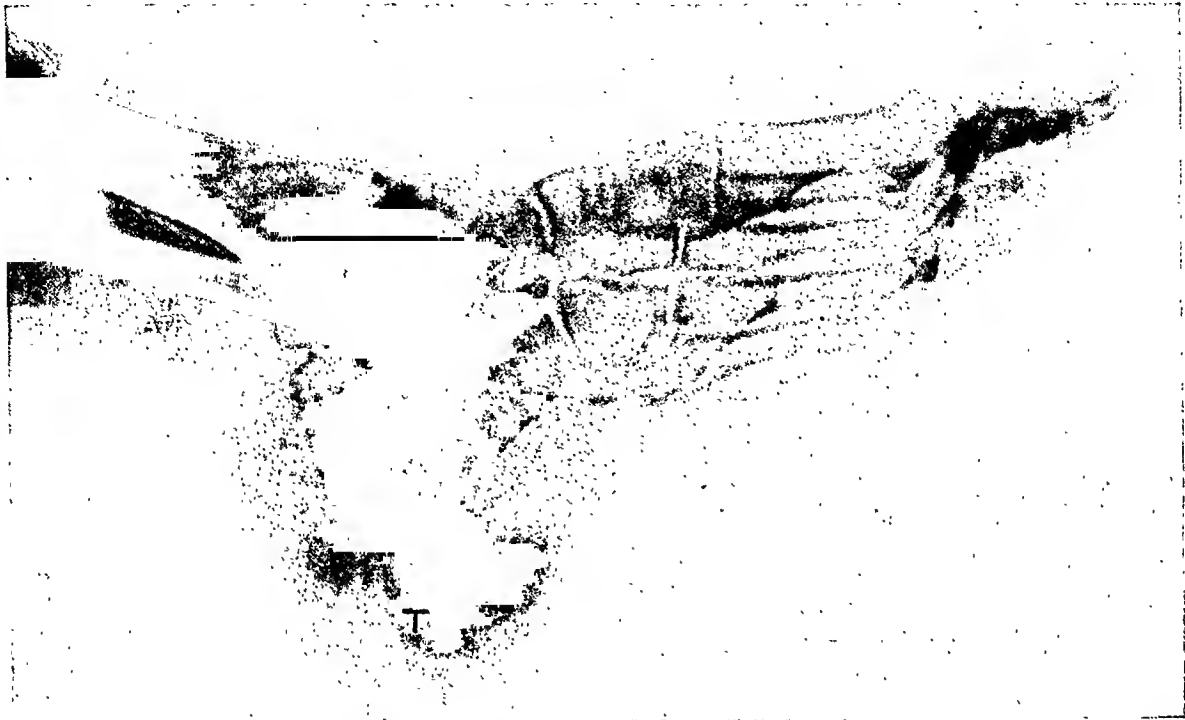


FIG. 8. Sarcoma of right heel. L'ombre injected through posterior tibial artery. Arteriogram shows artery dilated and newly proliferated at tumor. ATP, posterior tibial artery. T, sarcoma.

In arteriography of the extremities, puncture of the following branches is made: on the superior or inferior ulnar collateral artery in the arm; on the external pudental artery in the thigh; on the lateral superior artery of the knee or the medial superior artery of the knee in the fossa poplitea.

The incision method, as a rule, is performed with a local anesthesia and its results are definite. In this method, as in the percutaneous puncture, the peripheral portion of the extremity may be tightened by a tourniquet or compression by the finger to avoid flow of the contrast medium to unwanted parts.

The emulsion is warmed to body temperature previous to injection but must not be heated. Before use, the ampule containing the L'ombre is rotated gently to mix the emulsion well. When shaken strongly, it must stand some time till all the small bubbles disappear. Therefore it is better not to shake.

The quantity injected differs owing to

of our improved method only 3 to 4 c.c. are needed. In the thigh, leg, upper arm and forearm 10 to 20 c.c. are necessary, and in limited parts, such as the knee, the hand, the foot and the elbow, 5 to 10 c.c. are used. As a rule, the index of the determination of the quantity injected is a sensation of swelling in the part injected by the L'ombre.

It is important that the roentgen-ray exposure and injection of the emulsion be finished at the same time.

The needle is 0.6 to 0.8 mm. in diameter, but when the trunk of the artery is punctured a finer needle must be used. When the branch of the trunk is punctured, a needle with a large caliber can be used.

We always use a short and broad syringe, a Carrel hemostat and the Dechamps instrument which were improved and specially constructed for us for arteriography.

#### TECHNIC OF VISUALIZATION OF THE VEINS

For examination of veins it is essential



to examine small areas, especially in visualizing the valves. The tourniquet is placed and tightened distal to the valve



FIG. 9. Case VII. Fracture of rib. L'ombre injected into median vein of forearm. B, basilic vein. C, cephalic vein. V, venous valve.

which is to be examined. The blood in the proximal vein from the valve is ejected and the needle introduced into the vein immediately proximal to the tourniquet. Then the injection is begun. At the end of the injection the roentgenogram is made. In this case, the tourniquet is tightened at the central part to avoid flow of the contrast medium to the unwanted part. To visualize the subclavian vein, 10 to 20 c.c. of the emulsion are needed.

#### REACTION: CLINICAL OBSERVATIONS

In arterial encephalography with this substance no local irritating action on the vessels has been observed in 130 cases. Neither pulse rate nor blood pressure has been affected. In the majority of cases there are also no subjective symptoms but in some cases a slight paresthetic or swelling sensation in the hemisphere on the side of injection is felt. In a case of right cerebral tumor, a disturbance of sensation on the tip of the nose, angle of the mouth, left upper and lower extremity was observed. In another case a motor and sensory aphasia was observed; this symptom, however, entirely disappeared immediately after the injection, because it was caused by the interruption of the arterial circulation. Occasionally there is also a slight injection of the eye and a slight fever after operation, but these persist only two or three days. In the cases trepanated on the temporal portion where the Sylvian fossa is easily seen, twenty-four hours and two weeks after performance of arterial encephalography by L'ombre, no pathological changes on the meninges or the brain substance could be seen. Arterial encephalography and pneumo-ventriculography may be performed at the same time with safety.

In arteriography of the extremity, a temporary chill or shivering is occasionally observed. There is no pain during the course of injection and even arterial encephalography is performed with a local anesthesia.

In addition, as a reaction after intra-arterial injection of L'ombre, anaphylactic phenomena might be feared because L'ombre P and L'ombre E contain protein in the form of protalbinacid and the white of an egg. A series of experiments were carried out on guinea pigs. Three groups of animals were prepared for the experiments. In the first group 0.75 per cent solution of protalbinacid in physiological salt solution was injected; in the second group 1 per cent of it; in the third group L'ombre P was employed. One cubic



FIG. 10. Case VIII. Varicose vein of lower extremity. L'ombre injected into vein at dorsum of foot. Veinogram shows varicose veins in deep area.

centimeter of these solutions was injected subcutaneously; then, after twenty days, the animals were re-injected intravenously using the jugular vein, 1 to 2 c.c. being given gradually. The following results were obtained: In the first and second groups, the animals all died immediately after the re-injection with typical anaphylactic symptoms. In the third group, no anaphylactic symptoms were observed after re-injection. The control animals injected with horse serum under similar conditions, all died immediately after the reinjection from anaphylactic shock.

The protein in L'ombre *p* had evidently been so changed that it no longer was an anaphylactogen. The theoretical interpretation of these phenomena will be published later after further experimentation.

It could be seen, therefore, that one need not fear anaphylactic phenomena after the re-injection of L'ombre *p* and L'ombre *e*. No signs of anaphylactic symptoms have been observed in any of our clinical cases, and, as is well known, artificial anaphylaxis is difficult to produce in the human.

The elimination of iodine after intra-arterial injection of this emulsion is very slow; even after ten days the iodine reaction in the urine persists. Hence this intra-arterial injection of the fine emulsion might be used for nourishment and for iodine therapy.

By means of this method the following subjects have been studied: arterial encephalography for the diagnosis of cerebral tumor; the changes of the course of arteries in fracture or dislocation; determination of amputation in instances of peripheral gangrene; examination as to the site and extent of the collateral circulation after amputation of an extremity; the vascular condition in the extremity in spontaneous gangrene, in tumor of the extremity and after resection of the knee; in studying venous valves and varices or aneurysms.

The practical application of this method is illustrated by the following brief reports and plates.

CASE I. T. W., aged twenty-seven, male. Genuine epilepsy. Arterial encephalography was performed by means of this improved method, injecting 10 c.c. of L'ombre through the superior thyroid artery. Roentgenogram showed that all cerebral arteries were normal. (Fig. 2.)

CASE II. H. S., aged thirty-five, male. Diagnosis: tumor of the anterior lobe of the cerebrum on the right side. Arterial encephalography was performed by means of this improved method, 15 c.c. of L'ombre being injected through the superior thyroid artery, followed by stereoscopic roentgenograms (See Fig. 3) showing the following: i, ascending part of the internal carotid artery. ii, internal carotid artery in the carotid canal of the temporal bone. iii, internal carotid artery at the internal base of skull. A c, chorioid artery. s, middle cerebral artery, in abnormal course, displaced downward and backward at the Sylvian fossa. This showed that the tumor was situated in and coursed deeply into the anterior lobe of the cerebrum. A, anterior cerebral artery, in normal course. This showed that the tumor was not situated in and did not involve the opposite side of the hemisphere over the horizontal fissure of the cerebrum. A o, ophthalmic artery. v, lateral ventricle depressed downward by the tumor. In a part of the ventricle is seen a small amount of gas which was infused into the ventricle for the purpose of pneumoventriculography by puncture of the lateral ventricle on the preceding day. T, tumor. (Figs. 3 and 4.)

CASE III. H. D., aged thirteen, male. Diagnosis: fracture of humerus. On admission to the hospital one week after injury, it was noted that the left upper extremity showed marked swelling, colored violet-black, with an ulcer and marked decrease to pain sensation in the arm and forearm. After admission he developed extensive ulceration. The brachial artery was exposed near the axilla. L'ombre, 8 c.c., was injected into upper ulnar collateral artery after temporary tightening of the trunk by a clamp. Roentgen-ray examination showed that the radial and brachial arteries were amputated at the elbow. Arterial nets newly proliferated could be seen at the under border of the elbow, but no arteries to the periphery. Owing to this interpretation amputation was advised. AB, brachial artery. A, amputation of

the artery. c i, common interosseous artery. G, new proliferated arterial nets. (Fig. 5.)

CASE IV. T. I., aged forty-six, male. Diagnosis: Buerger's disease. One year previous periarterial sympathectomy on the right femoral artery was performed. For about three months after the operation the pain disappeared. Lately the pain had increased in the leg. On admission to the hospital, it was found that the right leg was very cool and showed gangrene of the hallux. In the popliteal fossa we could not feel pulsation. The femoral artery was exposed. Injection of 20 c.c. of L'ombre through the external pudendal artery. The roentgenogram showed that the popliteal artery was completely obliterated and only small arteries ran into the leg. Therefore the thigh was amputated. Anatomical examination of amputated leg showed the following: The popliteal artery was obliterated at its upper part, directly above the highest artery of knee and muscular rami anastomoses to the leg. The branches of the popliteal artery were all obliterated. But the anterior and posterior tibial arteries were not obliterated. A G S, arteria genu suprema. O, obliteration of the popliteal artery. (Fig. 6.)

CASE V. T. K., aged thirty-three, male. Diagnosis: aneurysm. The patient was beaten by a fist over his right temporal region. After three weeks he found a small tumor at that point; it was painful. The superficial temporal artery of the right side was exposed and 5 c.c. of L'ombre were injected. Arteriogram showed the tumor was a traumatic aneurysm (A in Fig. 7). (Fig. 7.)

CASE VI. T. M., aged sixty-three, female. Diagnosis: sarcoma of the right heel. The posterior tibial artery was exposed and 10 c.c. of L'ombre were injected. Arteriogram showed that the artery was dilated and newly proliferated at the tumor. A T P, posterior tibial artery. T, sarcoma. (Fig. 8.)

CASE VII. S. M., aged thirty-seven, male. Diagnosis: fracture of rib. Ten cubic centimeters of L'ombre were injected into the median vein of forearm. B, basilic vein. C, cephalic vein. V, venous valve. (Fig. 9.)

CASE VIII. M. K., aged twenty-five, male. Diagnosis: varicose vein of the lower extremity. Ten cubic centimeters of L'ombre were injected into the vein at the dorsum of the foot. In the veinogram the varicose veins in the deep area were seen. (Fig. 10.)

#### SUMMARY

Arteriography, which has not been generally used in practice because of troublesome reactions, is performed with perfect safety by means of the injection of a fine emulsion of iodized oil described herein. This method is valuable in the diagnosis of various circulatory conditions. It has been used to observe the course of arteries in fracture and dislocation; to determine the amputation line; to note the site and extent of the collateral circulation after amputation of an extremity; the vascular condition in the extremity in spontaneous gangrene, in tumors of the extremity and after their resection; in arterial encephalography; also in local blood vessel conditions, as aneurysm, varices and venous valve defects, etc.

This new contrast medium has given clear, satisfactory roentgenologic plates. It has also been used in pyelography, myelography and visualization of fistulae and articular cavities. For pyelography it is especially valuable because of the low viscosity, the absence of irritation of the mucous membranes, and the strong radioactivity, which insures very clear shadows.

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# HEMANGIOMATA OF THE INTESTINE\*

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**V**ASCULAR tumors of the intestinal tract are rare. They may cause obscure bleeding from the bowel, symptoms of acute inflammatory conditions, or intestinal obstruction. A case is reported because of the multiplicity and wide distribution of the lesions.

According to Kornmann<sup>1</sup> the hemangiomas constitute 7 per cent of all benign tumors, occurring most frequently in the skin. They are less common in the deeper tissues, where they involve mucous membranes chiefly. They have been observed in all parts of the digestive tract, from the lips to the anus.

In 1924, Brown<sup>2</sup> studied 19 cases collected from the literature and one which he reported. He recognized 4 types of tumors: (a) multiple tumors of the vascular arcades, which appear as reddish nodules situated in the submucosa and are connected with either the arteries or veins in the vicinity. These may be nevi or cavernous hemangiomata; (b) the submucous tumor which grows toward the lumen of the bowel and may ulcerate the overlying mucosa by pressure and trauma; (c) the submucosal tumor which may grow to such a size that it either obstructs the lumen of the bowel or causes a change in normal peristalsis producing intussusception; (d) the diffuse, ring-like tumor which begins in the submucosa, involves the muscularis, and constricts the lumen of the gut, producing intestinal obstruction.

The following data are based on 24 cases collected from the literature and the case described by the authors. Vascular tumors of the stomach were purposely omitted. Of the 25 cases 12 were in males and 13 in females. The ages of the patients varied from two months to seventy-nine years. There were multiple hemangiomas in 11 instances, and in 14 the tumor was single. In 18 of these patients there were

symptoms referable to the vascular lesions. Hemorrhage was the commonest finding, occurring in 9 cases. The hemorrhages were mostly small or intermittent, although in 1 case reported by Laboulbene<sup>3</sup> the patient died from a single massive hemorrhage from an ulcerated hemangioma in the duodenum. Four patients had symptoms of acute intestinal obstruction; 3 of chronic obstruction. In this group Paci<sup>4</sup> described a striking case in a woman in whom a large cavernous angioma was torn loose in the bowel during violent purging, and evacuated spontaneously with a large amount of blood. In cases reported by Shillito<sup>5</sup> and Landois<sup>6</sup> the findings simulated acute appendicitis and at operation cavernous hemangiomas were found in the ileum a few inches from the ileocecal valve. Nicoll<sup>7</sup> found a double intussusception at the site of a cavernous angioma.

In the 25 cases the tumors were distributed in the bowel as follows: duodenum, 2; small intestine, 15; colon, 1; rectum, 4; entire bowel, 2; not stated, 1.

Tuffier<sup>8</sup> reported a case in which the patient died from hemorrhage from two hemangiomas of the sigmoid after a similar lesion in the rectum has been successfully cauterized. Judd and Rankin<sup>9</sup> described a hemangioma which they removed from the duodenum after it had been located in roentgenograms. Roedelius<sup>10</sup> described a case of multiple cavernous hemangiomata of the jejunum in which he considered the tumors to be true neoplasms. Winternitz and Boggs<sup>11</sup> reviewed a case with multiple tumors involving the entire bowel in which many of the lesions had undergone malignant degeneration.

Most cases of this type with vascular tumors of the bowel can be cured by surgery. The difficulties encountered are few but important. First, the diagnosis of these

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cases before operation is rare. Second, many of these patients develop intestinal obstruction or have massive hemorrhage, and die in shock. Third, a few rare cases have multiple tumors involving too great an extent of bowel to permit resection.

#### CASE REPORT

**History:** Mrs. C. S. (No. 69212) an American housewife, of German parentage, age 43 years, came to the hospital in November, 1925 with the complaints of anemia; tarry stools; and burning pain in the pit of the stomach, associated with belching of gas, but unrelated to meals, and not relieved by food. She had noted tarry stools frequently for ten years, and during periods of constipation bright red blood was often passed in moderate quantities. She also complained of marked weakness, frequent headaches and attacks of dizziness. For years she had had a large number of blood tumors on her skin. New ones appeared at intervals. One had been ruptured accidentally, bled profusely, and healed with marked scar formation.

On several occasions previously she had been treated by blood transfusions. Following an attack of influenza in 1919 she had copious hemorrhages from the uterus which were cured by curettement. Hematuria had been noted on several occasions. She had had no infectious diseases except influenza. She remembered having been treated for anemia in childhood. There had been one normal pregnancy eight years before. Her parents and several brothers and sisters were normal and healthy. No other members of her family had any similar blood tumors.

**Physical Examination:** The patient was moderately underweight and very pale. The skin had a translucent appearance, with considerable pigmentation below the eyes. Scattered over the entire body, but chiefly on the back, buttocks, and legs, were a large number of vascular tumors, ranging in size from a pin-head to  $1\frac{1}{2}$  cm. in diameter. These were reddish or purplish-red in color. Some were entirely within the skin, others elevated, thin-walled blood sacs containing liquid blood and thrombotic masses, occasionally partially calcified. A few were pedunculated. They could be partially emptied by pressure. On the right leg just above the external malleolus there was a large stellate scar in a bluish discoloration where one of these tumors had been ruptured

by a blow. There were more than twenty of these tumors which exceeded  $\frac{1}{2}$  cm. in diameter. Three large ones were on the sole of the right



FIG. 1. Hemangioma of liver and single lesion in ileum.

foot. The mucous membranes were very pale. Two crowned teeth showed no pathology. The tongue was coated and along the left lateral margin was a cavernous hemangioma surrounded by dilated vessels. The tonsils were enlarged. There was no lymphadenitis. The isthmus of the thyroid gland was palpable. The lungs were normal. The heart was not enlarged, relative cardiac dullness  $9 \times 2$  cm.; rhythm regular, soft systolic murmur in the pulmonic area. Blood pressure, 150/80. The arteries were not thickened. The spleen was palpable on deep inspiration, but not tender. The uterus was retroverted. There were several external hemorrhoidal tags.

Serial x-rays of stomach showed normal findings. Fluoroscopic examination of the stomach showed hyperperistalsis. Barium enema showed the colon to be redundant and incompetency of the ileocecal valve. Rectosigmoidoscopic examination was negative except for a mild, generalized inflammation of the mucosa.

*Laboratory Examinations:* Red blood corpuscles, 2,540,000; hemoglobin, 42 per cent; moderate anisocytosis, poikilocytosis, reticulo-

had spent a great deal of time in hospitals being treated with blood transfusions and various types of diets. At this admission the

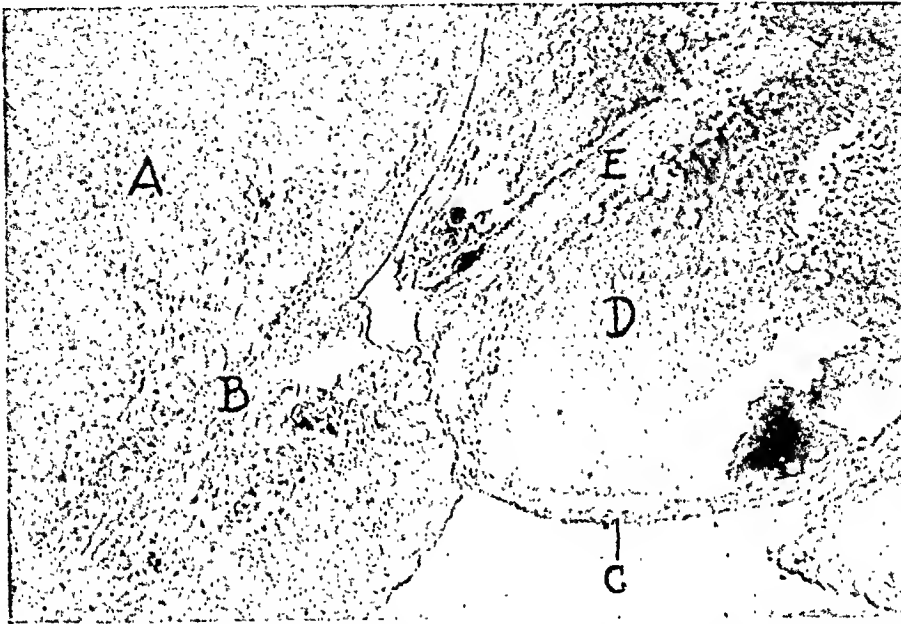


FIG. 2. Mrs. C. S. Section through cavernous angioma excised from liver. A. Normal liver tissue. B. Liver capsule. C. Fibrous capsule of tumor. D. Blood-filled cavernous sinus. E. Invaginating portion of tumor capsule.

cytes 1 per cent. Fragility of R.B.C., initial hemolysis 0.48 per cent, complete hemolysis 0.28 per cent, W.B.C. 6200. Differential, normal. Van den Bergh test, direct 0; indirect, low normal. Urinalysis: alkaline, specific gravity, 1.022. Albumin +, phosphates + + + +, leucocytes +, stools: mucus + to + + + +, guaiac + to + + + +.

*Course and Treatment:* A diagnosis of duodenal ulcer was made and after blood transfusion, the patient was placed on a modified Sippy diet. She returned three months later and reported intermittent bleeding from the bowel which was greatly increased by constipation. At this time the patient was still very weak. She was seen at the hospital clinic at infrequent visits for two years. In September, 1927 she entered the hospital very weak and anemic. R.B.C. were 2,200,000, hemoglobin 50 per cent and all the stools contained large amounts of blood. The bleeding time was normal; coagulation time was twenty-six and one-half minutes (Howell tube) and platelets were 210,000. The patient had had no abdominal pain for more than a year. After a review of the case a diagnosis of multiple hemangiomas of the intestine was made and an exploratory operation was advised. She returned in February, 1928 and consented to operation. Meanwhile she had been bleeding continually and

blood counts were the same as they were four months previously. The patient was given repeated blood transfusions as rapidly as possible, calcium lactate by mouth and parathyroid extract (parathormone) subcutaneously. The blood calcium was within normal limits and showed no increase after treatment. With the R.B.C. 4,050,000 and hemoglobin 62 per cent, operation was performed under ethylene anesthesia. An upper left rectus incision was made. When the abdomen was opened the liver border was seen with a large group of mulberry-like tumors from 1 to 3 cm. in diameter. The gall bladder was normal in appearance and could be emptied readily, although some of the tumors were adherent to its wall. The surface of the liver in the region of the gall bladder was thickly studded with large, protruding, thin-walled blood sacs which could be partially emptied by pressure. These showed evidences of thrombosis and calcification. The larger portion of the inferior surface of the right lobe of the liver was covered with masses of thin-walled sinuses filled with blood and surrounded by dilated blood vessels, some as large as 3 mm. in diameter. There were several cavernous hemangiomas on the left lobe of the liver. The spleen was hard, three times normal size and the capsule entirely covered by dilated blood vessels. In the anterior wall of the stomach



there was a dark discoloration just below the peritoneum. This proved to be a tumor mass 1 cm. in diameter, which felt hard, but could be partly emptied by pressure. There was a similar tumor in the posterior wall of the duodenum. Eight widely separated single tumors were demonstrated in the jejunum, varying in size from 2 mm. to  $1\frac{1}{2}$  cm. in diameter. Some were deep within the wall of the bowel, others appeared as firm, elevated, circular or oval plaques just below the peritoneum, and a few were pedunculated into the lumen of the bowel. At the site of one tumor, beginning intussusception was encountered, and readily reduced. There were a smaller number of tumors in the ileum. The largest one encountered, a short distance from the ileocecal valve, half filled the lumen of the bowel. No tumors were seen in the large bowel. The kidneys, appendix, tubes and ovaries were normal. Near the junction of the right tube, on the surface of the uterus, a small nodule was seen but this proved to be calcified and bore no resemblance to the vascular growths. One of the cavernous tumors on the border of the liver was excised. Sections showed a tumor mass composed of large, dilated blood spaces filled with red blood cells and lined by a single layer of epithelium. The walls were thin and fibrous. The adjacent liver tissue was normal.

The patient was discharged on the twelfth day after operation and was not seen at the hospital again. She died four months later of hemorrhage from the bowel. An autopsy could not be obtained.

#### COMMENT

Despite the widespread distribution of the vascular lesions in this case, there was no evidence to suggest that they were malignant. The four types described by Brown were all demonstrated in this patient. Interruption of normal peristalsis was clearly shown and intussusception encountered at operation. It seems proba-

ble that there were one or more lesions of the bladder mucosa similar to those in the bowel, because of the history of hematuria. Surgical relief in this case was impossible because of the large number and wide distribution of the tumors and the inability to tell from which ones the bleeding occurred.

#### SUMMARY

1. Although hemangiomas constitute a comparatively large percentage of benign tumors, they are not common in the bowel.
2. In cases of obscure hemorrhage from the bowel hemangiomata should be considered.
3. There are apparently four different types of these tumors, depending on the structures they involve and manner in which they develop.
4. Hemangiomas of the intestine are of importance because they may cause obscure bleeding from the bowel, symptoms of acute intra-abdominal inflammation or intestinal obstruction, acute or chronic.
5. Surgical cure is usually possible in cases with hemangioma of the gastrointestinal tract.

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# BILATERAL URETERO-SIGMOID ANASTOMOSIS BY THE COFFEY METHOD

REPORT OF 4 CASES\*

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THE problem of utilizing the rectum as a urinary reservoir has been before the medical profession for more than three-quarters of a century, or since Simon,<sup>1</sup> in 1851, first attempted to anastomose the ureters into the rectum in a male patient suffering from exstrophy of the bladder.

The indications for such a radical and dangerous procedure fall in general under two headings: (1) our object is to avoid urinary incontinence to the skin surface with the discomfort, inconvenience, and social ostracism which this condition often inflicts; and (2) when for extensive malignant disease it is desirable to remove the bladder or urethra, or to apply unusually radical radium treatment.

In cases of the former class we may desire to implant only one ureter into the bowel. This may be indicated when we have to deal with an ectopic ureter, a ureteral injury of a nature that does not invite an attempt at local repair, or an injury so high in the ureter that the renal end cannot be implanted into the bladder. In each of these conditions our choice lies between excising the kidney, tying off and dropping the ureter, or diverting the renal end to the other ureter. We may find a colon implant the most feasible method of dealing with a ureteral fistula which drains to the genital tract or skin surface, although, whenever possible, the ureterovesical anastomosis is preferable.

Probably the most common indication for the implantation of both ureters into the bowel has been found in the distressing congenital exstrophy of the bladder; but with improved technic it is likely that the field of the operation will be greatly extended to aid in the attack on advanced cancer of the lower urinary tract and on

cancer of the genitalia threatening the urinary function.

While much of the effort directed toward the solution of the problem of making the rectum serve as a common cloaca for feces and urine has developed as emergency surgery, in the attempt to take care of ureteral injuries, by far the most satisfactory progress has followed the deliberate effort to make life worth while for the unfortunate victim of vesical exstrophy. After many years of futile surgical effort to invaginate the exstrophied bladder in situ, (a procedure doomed to failure because of the lack of any sort of sphincter control, even after the bladder has been replaced below the skin surface) the problem was first successfully solved by Maydl,<sup>2</sup> who transplanted the trigonal area of the exstrophied bladder, together with the ureters, into the anterior wall of the rectum.

Moynihan<sup>3</sup> improved on Maydl's method by keeping the operation an extraperitoneal one, but this extraperitoneal method can be used only in the male.

In rapid succession reports now came from men working independently, in widely separated parts of the world, on a new extraperitoneal method of implanting each ureter separately into the side of the rectum, and at the same time preserving a button of the ureterovesical portion of the bladder, with the idea that this would retain the valve-like action of the lower ureter after its transplantation.

We have found this operation unsatisfactory in the female because of the difficulties of freeing the lateral vaginal attachments and bringing the rectum and ureter together without torsion of the ureter.

This operation is usually designated in

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the literature as Peters' method. But although George A. Peters,<sup>4</sup> of Toronto, published this method first in the *Canadian Lancet*, in 1899, and later in the *British Medical Journal*, June 22, 1901, Bergenhem,<sup>5</sup> of Sweden, had antedated him by about five years, and Pozza, of Italy,<sup>6</sup> had already reported a case before Peters' first publication. Moreover, Franklin Martin,<sup>7</sup> of Chicago, Capello,<sup>8</sup> of Rome, and London,<sup>9</sup> of Adelaide, Australia, had also preceded Peters in doing the operation, but had not reported until after Peters' first paper on the subject.

With this rapid development of methods offering sufficient promise of safety and success to warrant the deliberate adoption of one or other in a malady such as exstrophy of the bladder, it is not surprising that they should be finding wider application.

However, in spite of the progress made up to twenty years ago, diversion of the ureters into the rectum was still regarded as one of great danger and not to be employed under any but extreme circumstances. The gravity of the situation is best summarized by statistics gathered at about that time. In Zesas'<sup>10</sup> collected series of 97 patients operated on by the Maydl method there were reported as many as 26 deaths (or 27 per cent) following operation.

In Stevens'<sup>11</sup> series of 33 cases (26 collected by J. J. Buchanan<sup>12</sup> and 7 new cases added by Stevens,\* done by the Bergenhem or Peters' method, there was an operation mortality of 15 per cent. The postoperative results were about the same in the Maydl and Bergenhem operation, namely, about 65 per cent of the patients were reported as living after one year, and 25 per cent as having outlived a five-year period.

Carl Steinke<sup>13</sup> carefully summarized the operations on the human reported up to 1909 and found a mortality of over 50 per cent. Without doubt, if it had been possible to add the records of many

unpublished cases up to that time, the showing would certainly have been still more disheartening.

The recognized dangers in these methods were (a) peritonitis from faulty technique in the intraperitoneal operations; (b) localized abscess formation in either the intraperitoneal or extraperitoneal operation, or (c) compressions and twists of the implanted ureter resulting in stasis, infection, and prompt or gradual destruction of the kidney.

But thanks to the experimental work inaugurated by Robert C. Coffey of Portland, the past twenty years may be considered as marking an entirely new epoch in uretero-intestinal anastomosis. In doing research work on the pancreas Coffey had found it necessary in certain experiments to transfer the delivery end of the common bile-duct to a location lower down in the intestine. Transplantation was done by the direct method which had been in use up to that time; and, two weeks or more later, on opening his dogs for the pancreatic work he found in every instance that the bile-duct was enormously dilated. This led to studies, on the living dog, of the mechanism of entrance of the normal duct and the discovery that, after penetrating the muscle walls of the bowel, the duct runs for some distance under the loose mucous membrane before it emerges into the lumen of the bowel. Following this lead, Coffey then operated upon a series of 6 dogs, employing his newly discovered, indirect, submucous transplantation method, and was rewarded by finding that in none of these did subsequent dilatation develop. These investigations and experiments he at once carried over to the dog's ureter.

In his last paper<sup>14</sup> in which his valuable contributions of the past twenty years are reviewed and summarized, Coffey presents his perfected technique for using the indwelling ureteral tube or catheter to insure good renal drainage for the first few days after operation, or until enough time has elapsed for the operation edema

\* *Surg. Gynec. Obst.*, 8: 146, 1909.

and swelling of the anastomotic area to subside. This precaution, Coffey hopes, will to a large extent eliminate the risks of implanting both ureters at one operation instead of one at a time, as has been the general practice.

At the time Coffey's last paper appeared we were fortunate in having a patient in the Johns Hopkins Hospital suitable for uretero-bowel anastomosis. The case is briefly as follows;

*History:* J. H. H. U-no., 21,698. Negress, aged thirty-three years, para 8, complaining of complete urinary incontinence of three years' duration following her last delivery by a colored midwife. Family history, non-contributory. Personal history: a point of interest, which later proved to be of considerable importance, was the history of a lower abdominal operation nine years before, presumably for salpingitis. Physical examination, essentially negative except for the urinary condition. Examination in the knee-chest posture showed complete absence of the urethra. At a point 1 to 2 cm. above the former site of the internal sphincter was a vesicovaginal fistula about 13 mm. in diameter. The bladder mucosa, including the trigonum and ureteral orifices, appeared quite normal. A specimen and culture taken from each kidney were negative. A one-hour phenolphthalein test was made, 1 c.c. of the dye being injected intravenously; the left kidney secreted 450 c.c. and 30 per cent of the dye, and the right kidney secreted 200 c.c. and less than 10 per cent of the dye.

*Preparation of Patient:* She received the usual ward diet with breakfast omitted the morning of operation. Sodium acid phosphate was given to acidify the urine. Fluids were forced to 3000 c.c. daily. An ordinary soap-suds enema was given the night before and on the morning of operation.

*Operation:* Nov. 24, 1928. Under ether anesthesia the abdomen was explored through a suprapubic incision extending 4 cm. above and exceeding the umbilicus. The omentum was widely and densely adherent to the region of the former wound. The gall bladder and stomach appeared to be normal. The appendix was absent. The uterus was of normal size and consistence. A loop of small bowel densely adherent to the fundus was cut free and the edges of the raw area were approximated with

fine catgut sutures. The ovaries were slightly cystic and buried in dense adhesions behind each broad ligament. The sigmoid was densely adherent to the left pelvic brim and to the left ovarian region. These adhesions were freed, giving the sigmoid about normal mobility. A rubber-covered stomach clamp was applied to the sigmoid well above the pelvic brim and the patient was then pulled to the lower end of the table and placed in the lithotomy position. A long rectal speculum was inserted into the rectum by an assistant and, guided by the operator's hand in the abdomen, was pushed well above the pelvic brim. A rectal tube attached to an irrigator was introduced through the speculum into the bowel and a strong stream of water was played on the bowel walls as the speculum and tube were slowly withdrawn to within 1 in. of the anus. At this point irrigation was discontinued, the speculum was reinserted to occupy its former position in the sigmoid, and the sigmoid and rectum were carefully packed with a 5-yd. roll of gauze as the speculum was slowly withdrawn. A search was then started for the left ureter. This proved to be the most difficult step in the operation. The old pelvic inflammation had caused an enormous thickening of the peritoneum itself, and behind it was thickened infiltrated subperitoneal fat and dense fibrous tissue.

The ureter was finally located quite far lateral to its usual position and coursing around near the pelvic brim almost to the point of its entrance under the uterine vessels. It was freed from its retroperitoneal bed, doubly clamped and cut, its lower end being tied with No. 2 plain catgut and dropped. The right ureter was found in its usual position. It was traced down to its dip under the uterine vessels where it was clamped and cut, and the distal end tied and dropped. The sigmoid was then drawn up and suitable sites found for anastomosis, great care being taken to choose points high enough on the sigmoid to prevent tension on the implanted ureters when the bowel prolapsed back to its normal position. The bowel incisions were made on the anterior lateral surface at points best suited to receive the separate ureters. The seromuscular coats were slit for a distance of about 3 cm., exposing the submucosa. As often happens in these operations on the human, the walls of the sigmoid were found to be quite thin, making it somewhat difficult to push back the muscular

coats bluntly off the submucosa. Each ureter was split on its anterior surface for a distance of 15 mm. A No. 9 whistle tip x-ray catheter snugly fitted with a small rubber sleeve about 15 mm. long, and set about 12 cm. behind the tip, was introduced into the ureter. Two interrupted No. 00 catgut sutures brought the split flaps of the ureter up over the rubber sleeve and were tied lightly. Then just above the sleeve two No. 2 chromic catgut ligatures were tied tightly around the ureter in order to cause future sloughing and release of the catheter.

A small stab wound just large enough to admit the prepared ureter was now made in the lower angle of each bowel incision. Through this opening in the mucosa a straight Halsted clamp drew out a tiny cone of the gauze lying within the bowel, and the butt-end of each catheter was attached to the gauze by means of a strong linen thread on a small staphylorrhaphy needle. The butt-end of the catheter in the right ureter was first cut off obliquely in order to leave a beveled end for identification during convalescence. The gauze was then slowly withdrawn, the lower end of the catheters being brought out through the anus and the ureters being drawn into place without causing any undue tension. The ureters were anchored in the lower angle of the bowel incision by means of two No. 00 interrupted chromic catgut sutures, the operator picking up the serosa and muscle on one side and then taking a good bite of the ureteral wall, being careful not to penetrate the ureteral lumen, and coming out through muscle and serosa on the other side. Three No. 2 plain catgut sutures were then made to enfold the muscle and serosa over the ureters above the stab wound. To protect the right ureter at the site of the anastomosis the bowel was attached to the parietal peritoneum at the pelvic brim. Peritoneal flaps covered the left anastomosis. The peritoneum on either side of the pelvis was approximated over the former bed of the ureters. Three cigarette drains were placed in Douglas' cul-de-sac, and were separated from contact with the abdominal contents by a rubber protective dam. A rectal tube was placed in the lower bowel beside the catheters to combat distension. The catheters were covered with sterile gauze until the patient was returned to bed, and were then placed in a sterile urinal.

*Comment:* The completed operation took

three hours. Twenty minutes were spent in making the incision, exploring the abdomen and preparing the pelvic field. Another twenty minutes were consumed in irrigating and packing the lower bowel. Sixty minutes were wasted in locating the left ureter which had been so badly misplaced by the former pelvic inflammatory disease. In another case with a history or physical findings suggesting a former pelvic inflammatory disease, or with a history of a former pelvic operation, we would place catheters in both ureters before anesthesia in order to facilitate their rapid localization.

*Postoperative Course:* The patient returned to the ward in excellent condition considering the length of the operation. There was some nausea but no shock, vomiting or ileus. The urine came from the catheters at a normal rate. The day after operation long sterile rubber tubes were attached to the catheters and were led out over the end of the bed where they dripped into sterile bottles. This proved to be quite an improvement in the comfort of the patient and in determining at a glance the rate of flow from each kidney. The tubes were sterilized each day and the catheters irrigated with silver nitrate solution 1 to 5000. Subcutaneous salt solution (1500 c.c.) was given the first twenty-four hours, and water as desired. Liquid diet without milk was started on the third day. On the fourth day, the left kidney catheter stopped draining and there was nausea, and pain in the left flank.

Ordinary sterile ureteral catheter stylets were passed, encountering considerable salty deposit in the upper ends of the catheters. This procedure was followed by a free flow of urine and all symptoms subsided. The silver nitrate irrigation of the catheters was replaced by 2 per cent boric acid solution and sodium acid phosphate was given by mouth to return the urine to an acid reaction. The stylets were passed on the fourth and fifth days and after this there was no more blocking. In passing the stylets we were embarrassed by the fact that the excess length of the catheters had been cut off in the operating room, and we had to be guided solely by the sense of resistance and by the flow of urine in deciding when the comparatively sharp stylet had passed to the end of the catheter. (Coffey recommends the use of a stylet with a small braised bulb on its tip, thus obviating the dangers of the pointed end.) On the evening of the eighth day, following a mild cathartic, 180 c.c. of oil were

given as a retention enema. The evening of the ninth day both catheters were freed during a bowel movement, the ureters having sloughed

the right and left having been present before our surgical interference.

The wound, except the sinus, created by the

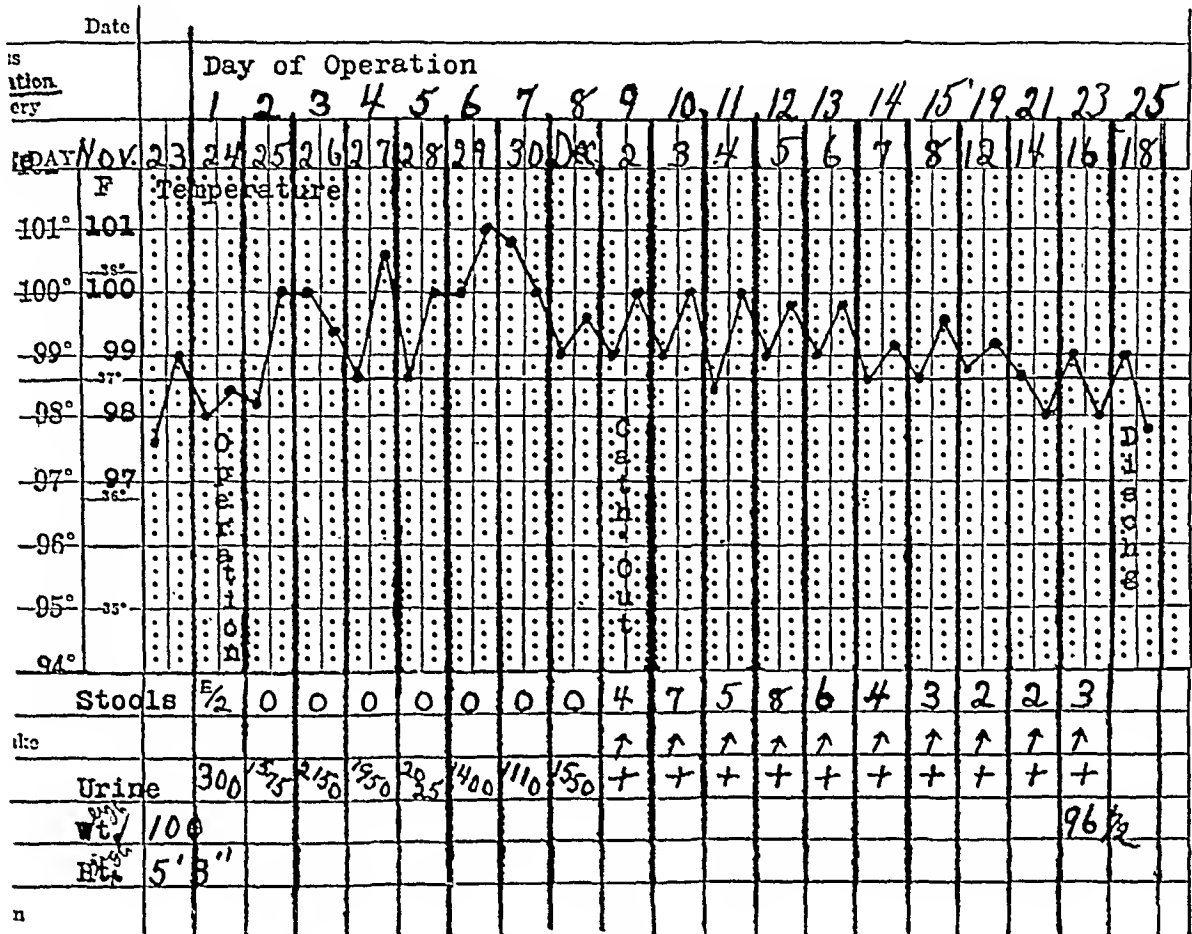


FIG. 1. Chart of Case 1.

at the constricting ligature above the rubber cuffs. During the next six days there were 4 to 8 fluid stools daily and the patient complained of anal irritation. This rapidly cleared up and by the sixteenth day the patient was averaging 3 to 4 fluid stools a day and about 1 during the night without discomfort. Several phenolphthalein tests were made while the catheters remained in position. One c.c. of the dye was injected intravenously and bilateral collections were made for one hour. The results were as follows:

Time after Operation, Hours	Right Kidney, Per Cent	Left Kidney, Per Cent
24	5	65
96	5	75
112	5	48

(part of specimen lost)

From these results we feel there was no impairment in the kidney function due to the operation, the discrepancy in function between

drains, healed *per primam*. There was a good deal of watery brownish discharge after the third day associated with a colon odor. Methylene blue was given by mouth without recovery of any of the blue dye on the dressings, and we concluded that the discharge was due purely to localized infection. Two of the suprapubic drains were removed on the eighth day and the remainder on the ninth, followed by a rapid granulation of the sinus. The patient was discharged twenty-five days after operation. She was then without any annoying symptoms and was so pleased with the results that she announced plans of a speedy marriage. The temperature chart shows a maximum of 100°F. after the extrusion of the catheters. Repeated examination revealed no tenderness in the kidney regions, and there was nothing to indicate renal infection except the slightly elevated temperature for the first thirteen days, which undoubtedly was partially due to the suprapubic drainage. (See Fig. 1.)

While the use of the indwelling catheter was advocated by Franklin Martin<sup>15</sup> in his early experiments on dogs, and was adopted by Peters in some of his later operations on the human, it has remained for Coffey to perfect a comparatively simple technic which insures the retention of the catheter in the ureter and its expulsion at about the time the tissues in the anastomotic area should be ready for free drainage from the ureter into the bowel.

Although Coffey and most of the experimenters and clinicians who have written on uretero-bowel anastomosis believe that we now have a technic that will prevent kidney infection, we are not at all sanguine that such perfection can be obtained. With this latest Coffey method, certainly the best that has yet been devised, we have the sloughing of the lower end of the ureter within the bowel lumen, characterized by its rich flora of pyogenic organisms, and the end of the large catheter acting as a foreign body within the ureteral lumen. It would seem that the only sequel to such conditions must be an ascending infection, either by the urinary channel, or by way of the blood vessels and lymphatics of the ureter. Our ureteral stricture work has shown that the kidney is capable of spontaneous recovery, even from long continued infection, if it be given perfect drainage, and it is probable that the best we can do is to so perfect our operative technic that, when the catheters are out and the tissues of the anastomotic area have returned to normal, the kidneys will have sufficiently good drainage to enable them to throw off the infection. We know from experience that with reasonably good drainage the kidneys may tolerate a low grade pyelitis for many years without giving rise to serious subjective symptoms.

McKenna<sup>16</sup> reports a series of experiments on dogs in which he did uretero-intestinal anastomosis by the Coffey tube method, transplanting only one side in order to make late control studies. These

dogs were anesthetized at periods varying from one to two years later and catheters were passed to each kidney for study of the two separate urines from the microscopic, bacteriologic, and functional viewpoints. These studies showed the urines to be negative microscopically and to culture, and the functional value was equal or only slightly reduced on the operated side. In dogs 6 and 7, in which autopsies are reported, the kidney on the operated side showed scarring and thickening of the capsule. In dog 10, on which a ureterovesical anastomosis had been performed by the same method, there was marked hydroureter and hydronephrosis and a colon bacillus infection on the operation side, due to a constriction of the ureter at the anastomotic area. McKenna's results are remarkably good, but they tend to bear out our contention that there is a preliminary injury to the kidney and that the ultimate result depends largely on the degree of the drainage obtained.

In another case we would not use the x-ray catheter, for the bismuth catheter of a given size does not have as large a lumen as the plain catheter of the same size; moreover, the retained bismuth catheter undergoes more rapid abrasion than the retained plain catheter, thus favoring the deposit of urinary salts. Coffey recommends the use of No. 12 catheters, but we would prefer a No. 9 or 10 in the adult ureter, fearing that the No. 12 is large enough to cause a certain degree of ischemia in the ureteral walls.

Although it has been the custom to transplant but one ureter at a time, it so happened that the three operations in which the Coffey method was used, before the one already described as done by his improved tube method, were all performed upon patients who presented emergency conditions which made it seem wiser to complete the bilateral implantation in one operation. These three operations were reported in brief<sup>17</sup> in 1924, and it may be of value to review them here, and to make a late report on the two patients still living.



CASE 1. Our first case was that of a woman thirty-three years of age, who eighteen months previously, at her first labor, had had a difficult forceps delivery, resulting in complete destruction of the urethra and leaving a large vesicovaginal fistula. An ineffectual attempt had been made to close the defect by interposing the uterus between the base of the bladder and vagina. She was a blonde with thin skin and mucous membranes, and her suffering from the excoriation and urinary salts deposited had been such that she would not allow a preliminary examination without a general anesthetic; also, she begged us to do everything that was possible with the one anesthesia.

On November 1, 1918, we performed the double implantation by the Coffey submucous method without the use of drainage catheters. In September, 1921, she returned for inspection and gave a history suggesting mild attacks of pyelitis on alternate sides at intervals of about six months. High rectoscopy revealed an area of red granulation, presumably about the region of the left ureteral orifice, for the left implant had been made at a point lower down than the right. We interpreted this evidence of continued inflammation as being due to the linen through-and-through fixation suture which Coffey originally recommended and which we used in this infected area under mental protest, predicting that a continued chronic inflammation about a linen suture might lead to serious results from stricture formation.

About a year later, in the fall of 1922, and about four years after her operation, the patient, while doing a good deal of cold surf bathing at Atlantic City, developed well-marked signs of a pyelitis in the left kidney. The left orifice could not be located in the granulation area, and we therefore decided to expose the left kidney, planning to leave a permanent drainage catheter to the kidney pelvis if we failed to do a retrograde dilatation of the ureterosigmoid stricture. The kidney was found enlarged, but seemed to have an excellent firm cortex as if from compensatory hypertrophy. There were no signs of cortical abscess. The pelvis was only slightly enlarged and the ureter, which had a diameter of 15 mm., was distended by a thick purulent material. Through a pyelotomy incision I was able to dilate the ureterosigmoid narrowing up to a 7 mm. (21 Fr.) bougie. After a stormy

convalescence the patient was finally discharged in fairly good condition.

About a year later, or in June, 1923, she



FIG. 2. Ureteral implant, left kidney.

returned for general investigation. She had been able to perform her household duties with but little discomfort. There had been occasional pains "like indigestion" in the upper left quadrant, and at such times there seemed to be a tender mass in this region. These attacks were more likely to occur around the menstrual period. The appetite had been poor, and at times, on first arising in the morning, there had been nausea. The bowels had a tendency to constipation. The bowel control was good, her regular night's rest extending from 10 P.M. to 6 A.M. without use of the commode. On examination, the patient had a good color and appeared to have gained in weight. The blood chemistry showed

Non protein nitrogen . 54.9 mg.  
Urea..... 27.2 mg.

Rectoscopy showed absence of the former inflammatory areas about the ureteral orifices. Attempts to catheterize the right ureter resulted in the catheter doubling back into the rectum. The No. 8 x-ray catheter entered the



left ureter until the small wax bulb met the ureteral orifice. When slight force was used the bulb was seen to fold back on itself. The catheter was withdrawn and the bulb was smoothed down to a smaller size, but it was again stopped at the ureteral orifice. A bilateral functional test was unsatisfactory. Part of the dye entered the vein and part of it escaped as an extravenuous injection. In one hour the left kidney secreted through the catheter 90 c.c. of urine with 8.5 per cent of the dye. We failed to recover an appreciable color test from the right side through the rectum. The urine from the left kidney showed many epithelial cells, many erythrocytes (trauma), leucocytes, and bacteria. A culture was positive but the laboratory did not identify the organisms. A good urogram was obtained (see Fig. 2). At the operation in 1922 we thought from the appearance of the left kidney that it had undergone compensatory hypertrophy, and this functional test made us rather more certain that the right kidney was doing but little, if any, work.

In March, 1928 the patient returned, reporting that she had been more free from nausea than for several years; the appetite had improved, and she had added some weight. But for the previous three months she had been having increased pain in both kidney regions, one attack on the right side requiring morphine. On sigmoidoscopy the bowel mucosa appeared normal. One ureteral orifice was located because of its repeated spurts of urine, a fine stream of clear-looking urine being projected 3 cm. beyond the orifice. We considered this as coming from the left kidney because of its comparative volume and because of our previous estimate that the left kidney was doing the chief work. An attempt to introduce a No. 8 renal catheter failed, the catheter tip entering only about 1 cm. A No. 7 renal catheter, and a fine metal searcher with slightly curved end, both failed to enter beyond 1 cm.

During the first twenty-four hours after this trauma to the already narrow ureterobowel area the temperature arose to 102°, there was much nausea, and the left kidney region was extremely sensitive, indicating that we had been working on the left ureter.

Forced fluids by the Murphy drip method (soda bicarbonate and glucose solution) soon restored the patient to her usual condition, and we decided to again expose the left ureter near the kidney and do a retrograde dilatation of the narrow bowel area.

We operated on April 5, 1928, placing the patient in the right lateral position and attempting to expose the ureter extraperitoneally near its origin from the kidney. Although the lower third of the kidney was easily exposed, we failed to locate the ureter, and fearing to prolong the operation it was abandoned after a twenty minute search for the ureter.

A letter from the patient September 19, 1929 says, "I intended to go down to see you last spring but was feeling so well I forgot. I have had no trouble with my side for over a year. The voiding varies with my general health, sometimes every hour at night, sometimes only a few times. I am able to retain longer in the day."

CASE II. Our second case was that of a woman forty-one years of age, mother of two children, aged sixteen and thirteen years. This patient entered the Johns Hopkins Hospital August 16, 1920, with almost complete anuria of four or five days' duration. Seven months previously a panhysterectomy had been performed for epithelioma of the cervix, and during convalescence radium had been used in the vaginal vault. The patient had gained 25 lb. since operation and had felt well up until two weeks before entering the hospital when she began to have nausea and backache. The day before admission her physician had found a mass in the right upper flank. On admission she was manifestly in a state of uremia. The mental reaction was much delayed, there was general anasarca, and a heavy urinous breath. On examination there was found in the left broad ligament region an indurated mass the size of a hen's egg, and in the right broad ligament region a mass the size of an English walnut. The left kidney was not palpable, and there was no tenderness in this region. The region where the left ureter should cross the pelvic brim was tender. The right kidney was distinctly enlarged and moderately tender. On cystoscopy there was slight redness about each ureteral orifice. A No. 9 catheter was introduced up to each kidney, meeting decided resistance in the broad ligament regions. A steady stream of urine flowed from each catheter, 270 c.c. from the right side, and 20 c.c. from the left. A two-hour phenolphthalein test yielded a total of about 5 per cent of the dye. Cultures from the kidneys were negative. The catheters were left in for drainage. On August

18, one day after placement of the indwelling catheters, the non-protein nitrogen was 70.89 mg.; per 100 c.c. The kidneys were irrigated daily with 1 to 5000 silver nitrate solution, and on August 20., after three days of catheter drainage, the pelvis took to the point of discomfort 23 c.c. on the right and 24 c.c. on the left.

The catheters were withdrawn on the seventh day, the evidences of uremia having disappeared. Within three days the patient was again mentally stupid, the face was puffy, the breath heavy; there were intense headache, nausea and vomiting, and total suppression of urine. On consultation with Dr. Burnam, it was thought there might be a slight chance for the patient if we could use heavy radium dosage after diversion of the ureters into the bowel. The catheters were reintroduced and the uremic symptoms again promptly cleared.

On September 4 an intramuscular test with the phenolphthalein yielded in three hours, right kidney 20 per cent, left kidney 17 per cent. After the indwelling catheters had remained this second time for a period of three weeks the patient's hemoglobin was 70 per cent and her general condition seemed to justify operation. Manifestly this was a case for bilateral implantation at one sitting.

We operated on September 14 by the Coffey submucous implantation method without the use of catheters. Our indwelling catheters were of great assistance in locating and isolating the lower ends of the ureters, and no special difficulties were encountered. The liver and upper abdomen seemed free from metastases. We did not find any enlarged lumbar or inguinal glands, but the broad ligaments showed widespread brawny induration, which necessitated rather high amputation of the ureters. The wound was closed without drainage and the patient's convalescence was surprisingly comfortable, probably largely as a result of the preoperative month in bed. The collection of urine from the rectum on the second day was 800 c.c. and on the third day 1600 c.c. The highest temperature, 102.2° F., occurred on the third day when the patient complained of slight chilly feelings and of some soreness in the kidney regions where on palpation there was moderate tenderness. From this time forward the convalescence was normal, and at no time were there further signs or symptoms referable to the urinary tract.

On October 18 the patient was sent to Drs. Kelly and Burnam for radium treatment. She was seen at home on December 11, three months after the operation, when she was taken suddenly with a copious vaginal hemorrhage. There was a large fungating mass in the vaginal vault, and the pelvic mass had become much larger and was encroaching on the bowel posteriorly. She died within a few days. Unfortunately, an autopsy was not permitted.

CASE III. A colored woman, aged thirty-eight years, was operated on at the Garfield Memorial Hospital in Washington on June 7, 1921. As in the case of the first patient, she was suffering from destruction of the base of the bladder and urethra. Her injury had followed a labor of one week's duration, and she had suffered complete incontinence for twenty-one years. Our abdominal incision was made through 4 in. of fat; she had an unusually deep pelvis, and her internal genitalia were buried in adhesions, making it difficult to find and free her ureters. Because of the difficulties of operation we established drainage. Her highest temperature for the first two weeks was 99.5° F. on the day of operation. Then on the fourteenth day she developed a temperature of 101° F. which was found to be due to an abscess in the abdominal wall. After this had been dilated the temperature dropped again to normal. About two months after the operation her physician wrote me that she had developed a fistula with slight leakage of urine and feces through the abdominal wound, but that she was putting out large quantities of urine through the bowel. The difficulties of this operation were so great that we felt it would be safer to leave our drains in place but we are inclined to charge the occurrence of the fistula to the fact that the wound was drained.

A recent report from Dr. Warfield of Washington says that this patient returned to the clinic for observation in June, 1926, five years after operation. At this time she was free from symptoms and seemingly was enjoying perfect health. In September of the same year she returned, complaining of frequency and rectal pain on voiding. Examination revealed a highly acid urine and all symptoms ceased after alkaline therapy. Recent search failed to locate the patient.

#### CONCLUSIONS

We have reported 4 cases of bilateral

uretero-bowel anastomosis by the Coffey method of submucous implantation.

In the first 3 cases the conditions were such that we felt obliged to do bilateral implantation at one operation instead of following the two-stage method then generally in vogue. In the last case we chose the bilateral method without question, because of Coffey's more recent refinements of the indwelling catheter method, which adds materially to the safety of the bilateral implantation.

With the exception of Case III in which abdominal drainage was instituted and resulted in the development of a temporary fistula two weeks after operation, each of our patients had a surprisingly smooth convalescence beginning immediately after operation.

The first patient is in fairly good health eleven years after operation, although she

probably has stricture at the anastomotic areas and bilateral chronic pyelitis. We ascribe the stricture condition to the use of permanent retention sutures originally advised by Coffey, but later discontinued on the advice of Charles Mayo. The second patient died three months after operation as a result of the extension of a widespread recurrent cervical cancer. This patient undoubtedly had mild acute bilateral pyelitis immediately after operation, but the urological features of her convalescence were probably as ideal as we can anticipate after this operation. The third patient was living five years after operation and apparently in perfect health. The fourth patient, in whose case the indwelling catheter method was employed, had as ideal a convalescence as we can reasonably anticipate, as is shown by the postoperative history and chart presented previously.

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# BENIGN LESIONS OF THE ANUS AND RECTUM\*

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## PHYSICAL EXAMINATION OF PATIENTS WITH DISEASES OF THE ANUS AND RECTUM

THERE can be no doubt that the development of the diagnosis and treatment of anorectal diseases have lagged considerably behind that of other branches of surgery. False modesty on the part of both patient and physician with respect to confidences concerning, and manipulations about, the lower intestinal tract has been one factor tending to retard the natural growth of the science of proctology; but perhaps a more important factor has been the relative difficulty of making adequate examinations of the anus and rectum on account of the natural inaccessibility of the area involved.

If that branch of surgery under discussion is to develop satisfactorily in the future, it will do so only as a result of the concerted effort of all surgeons to be as thorough in their proctological examinations as they are in their other physical examinations.

Inspection and palpation are the only two methods of physical examination which are of value in the diagnosis of proctological diseases, and it therefore becomes incumbent upon the examiner to place the patient in as favorable a physical position as possible for examination, in order that the most may be made of the two senses upon which he must depend for a diagnosis.

Three positions, with modifications, have been advocated as suitable for the purpose of routine proctological examination, (1) the right or left lateral; (2) the knee-chest position, and (3) the inverted position. Of the three there can be little doubt that the last-named is the best. The inverted position may be approximated by making use of such physical facilities as may be ordinarily at hand, but it is most conveniently achieved by the use of a specially

constructed examining table. In the inverted position the patient's legs and thighs are horizontal and on a level with the examiner's waist; the trunk, neck and head are dependent and make with the thighs an angle only slightly greater than 90°.

The knee-chest position is more easily assumed by the patient than the inverted position, and is only slightly less satisfactory for the examiner.

The lateral position, best modified to the typical Sims' position, is somewhat more comfortable from the point of view of the patient, but very much less satisfactory than the other positions for the purposes of the examiner.

The Sims' position is achieved as follows: the patient is made to lie on the left side with the legs flexed upon the thighs and the thighs upon the abdomen; the dependent shoulder and arm are pulled backward so that the patient lies on the side of the face and partly on the anterior as well as the lateral wall of the chest; the upper thigh is flexed to a somewhat greater extent than the lower so as to allow the knee of the former to touch the bed or table upon which the patient is being examined.

The standing position with the trunk flexed and the squatting position, with the thighs and knees flexed, are both quite unsatisfactory for purposes of proper routine examination, though they may be of occasional value under special conditions and for special purposes.

The inspection of the anus and perineal region externally need occasion no special comment.

The palpation of the interior of the bowel with the examining finger is a matter of no technical difficulty, but to be satisfactory must be done with gentleness,

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and the examining finger must be well lubricated.

Simple internal hemorrhoids cannot be diagnosed by the examining finger with accuracy; when clearly palpable they are the seat of thrombosis or fibrosis.

Many other internal conditions fall within the same classification; they must be visualized to be diagnosed with accuracy.

The use of special instruments for purposes of visualizing the interior of the lower bowel is a matter requiring particular mention. Many pieces of apparatus have been devised for the aforementioned purpose, and are called anosopes, proctoscopes, or sigmoidoscopes, in accordance with the part of the digestive canal for the exploration of which they are respectively designed.

E. G. Martin, of Detroit, is authority for the statement that 95 per cent of anorectal diseases are located within 1½ in. of the anocutaneous margin, and because of the frequency of lesions at and just above the anus, the anoscope is the most important instrument in the entire armamentarium of the surgeon who attempts proctological examinations. Any instrument is suitable for use, as an anoscope, which permits the adequate visualization of the area in question and produces no local trauma. The instrument may be a bivalve affair, may be a modified Sims' speculum, or may be of any other convenient design or shape; but whatever its design it should be so constructed mechanically that it permits relatively painless introduction and manipulation, because painful examinations are invariably unsatisfactory ones. Hollow tubular instruments are often of little or no value as anosopes, because they tend to cover the critical area either partly or completely.

The special province of the hollow tubular instrument is the inspection of the ampulla of the rectum and the regions above. The long sigmoidoscope under favorable circumstances enables direct inspection of the interior of the lower bowel from the anal margin to the "highest

point in the abdomen to which the sigmoid may be elevated."<sup>1</sup> In the inverted position the point of the instrument can often be made to reach the level of the umbilicus, and in the case of a thin subject, when tilted forward, can be palpated through the anterior abdominal wall at this level. The height may vary in other cases from the level of the promontory of the sacrum to the uppermost part of the abdomen.

It must be emphasized, however, (1) that in attaining the higher levels more or less traction must be exerted on the mesosigmoid, and (2) the interior of the sigmoid flexure is the only part of the colon visualized; no instrument has ever been designed which under normal conditions can visualize the descending colon. The height to which visualization can be performed in the sigmoid is, accordingly, almost entirely dependent upon sigmoidal mobility, i.e., the length of the mesosigmoid.

In conducting examinations high in the lower bowel the following principles should be respected:

1. As little pain as possible should be caused to the patient.
2. The shorter the instrument the better, provided the length is adequate.
3. The larger the lumen of the instrument, the better as far as visualization is concerned.
4. The area beyond the highest point of the instrument should be inflated.
5. Illumination should be adequate; electrically lighted instruments are valuable but not indispensable, since reflected light may be used satisfactorily.
6. The point of the instrument, once it has reached the ampulla, should always be advanced under the direct guidance of vision; the obturator should be removed and inflation should be invoked so as to balloon the intestine in front of the advancing point of the instrument.
7. The lumen of the intestine must, of course, be empty and the mucosa relatively clean.
8. The use of the sigmoidoscope is by no means devoid of danger; the intestine,

when the seat of ulcerations and other degenerative processes, is sometimes very friable and easily perforated. Manipulations must be performed with much gentleness, because it is sometimes easily possible to penetrate the bowel and cause the instrument to enter the peritoneal cavity or do damage to contiguous structures.

Either the inverted or the knee-chest position is almost indispensable in the satisfactory performance of sigmoidoscopic examinations, since only in these positions do the intestines fall fully away from the hollow of the pelvis, and thus aid in establishing pressure relationships favorable to the ballooning of the rectum; expansion of the rectum by unaided inflation through the sigmoidoscope or proctoscope may be rather difficult in the lateral position, especially in patients in whom the sphincters are not sufficiently competent to prevent reflux of air past the external wall of the instrument. Incidentally, in the lateral position the cramped posture of the examiner makes observation difficult.

When the proctoscope or sigmoidoscope is used one of the important prerequisites to a satisfactory examination is an empty and clean bowel. For purposes of cleansing the bowel the simpler enemas are to be preferred, either plain water, or water to which has been added a small amount of some bland substance like sodium chloride, sodium bicarbonate, or boric acid, since a bowel which is giving rise to symptoms and which, therefore, requires examination, is apt to be already the seat of considerable irritation. Soap, glycerine, alum, or turpentine, when brought into contact with the mucosa of such a bowel, are apt to aggravate the abnormal condition already present.

#### CONGENITAL MALFORMATIONS OF THE RECTUM

According to Starr, congenital malformations of the rectum occur in about 1.01 per cent of cases.

The classification of congenital mal-

formations, according to Wood-Jones, is now preferred rather than the older classification of Pappendorf, because the former is more in accordance with present conceptions of embryology. According to Wood-Jones, malformations are dependent upon: (1) irregular or arrested development of the proctodeum; (2) irregular or arrested development of the post-allantoic gut; and, (3) complete or partial persistence of the communication of the hindgut with the cloaca.

The following abnormalities represent the common types:

1. No invagination of the ectoblast occurs at the anus.

2. Invagination of the ectoblast at the anus is rudimentary and the anal membrane is either imperforate or persists in an incomplete form.

3. The post-allantoic gut is arrested in its descent, and ends blindly at a high level.

4. The post-allantoic gut descends to a lower level than normally but in a plane posterior to the proctodeum; both post-allantoic gut and proctodeum end blindly.

5. The cloacal partition does not form normally, and a communication remains patent between the rectum and the structures in front.

These abnormalities translated into clinical terminology represent the various forms of so-called imperforate anus.

1. *Imperforate Anus*, properly so-called, represents a condition in which the anal canal and rectal canal do not join, but in which the dividing septum between the two is so thin that the rectum bulges on the perineum whenever the infant cries or strains. The unrelieved condition, being inconsistent with prolonged life, is found only in infants, and is characterized by the fact that no meconium is discharged and the abdomen of the infant progressively enlarges. The treatment consists in puncture of the anorectal septum and subsequently repeated cautious dilatations of the opening thus made.

2. *Stricture of the Rectum* is a develop-

mental anomaly, consisting of an area of narrowing at the point at which the anal canal joins the rectum. The condition, unless extreme, is not usually recognized until about the age of puberty. If recognized early it should be treated by graduated dilatations at intervals of one to several days.

3. *Imperforate Rectum* represents a condition in which an unbroken septum or partition occurs about 2 in. above the anus. It may or may not bulge when the infant cries or strains, depending upon its thickness. The treatment like that of imperforate anus consists of puncture of the membrane and graduated dilatations.

4. *Agensis of Rectum and Anus* represents a more radical failure of development of the lowermost bowel. The end of the rectum is so far separated from the perineum that no bulging occurs on straining. To determine the level of the end of the rectum is sometimes a most difficult matter preoperatively, but the only available treatment consists in locating it by some suitable surgical procedure and suturing it to the skin of the perineum if possible, but if not, to the skin of the inguinal region, thus forming an inguinal colostomy.

5. *Persistence of the Cloaca* consists of a condition in which the rectum opens anteriorly into the bladder, urethra or vagina, or occasionally into the vulva or onto the perineum. Of all the congenital deformities this is the most serious, both because of the inherent nature of the deformity and also because of the frequency with which additional and unassociated defects present themselves in these cases, cleft palate, spina bifida, and hypospadias.

The treatment consists in preserving a free opening for the passage of feces from the rectum to the perineum until a subsequent plastic operation to reconstruct the normal anatomy of the parts can be performed. The latter is usually not feasible until the child is at least three years of age, and not infrequently preliminary colostomy is required even then.

## HEMORRHOIDS

Hemorrhoids are by far the most frequent lesions of the anorectal region with which the surgeon is required to deal.

*Definition:* Hemorrhoids are benign tumors or swellings containing varicosities of the hemorrhoidal veins and are usually accompanied by more or less infiltration of the surrounding tissues and hypertrophy of the anal skin.

*VARIETIES:* Three general classes of hemorrhoids are described:

1. The internal variety, covered by mucous membrane.

2. The external variety, covered by skin, and

3. The interno-external, covered partly by skin and partly by mucous membrane.

Internal hemorrhoids represent varicosities of the superior (possibly sometimes also, the middle) hemorrhoidal veins.

External hemorrhoids represent varicosities of the inferior hemorrhoidal veins.

Interno-external hemorrhoids represent varicosities of both sets of veins, superior and inferior.

External hemorrhoids are subdivided into three classes:

(a) *Thrombotic*, in which an acute process of clotting or coagulation has occurred within the veins of which the hemorrhoid is composed.

(b) *Integumentary*, in which the skin covering the hemorrhoid is thickened, usually as a result of previous thrombosis, and

(c) *Varicose*, which is the simple type and is represented merely by a mass of simple dilated and tortuous veins below relatively normal skin.

Thrombotic hemorrhoids characteristically develop with some suddenness, and seem to the patient much larger than they really are. In appearance they are usually of a dusky bluish or purplish hue, and range in size from 0.5 in. or less to 2.5 in. or more in diameter. They are characteristically very tender and painful.

The integumentary type consists of a sac or pouch of thickened skin which



represents all that remains of a prior thrombotic hemorrhoid which has undergone partial absorption.

The varicose variety consists merely of a mass of dilated tortuous veins situated either just at, or just outside, the anal margin.

Internal hemorrhoids occur in two fundamental types:

(a) The capillary or granular, which represents a minimum of tumor formation, and is characterized by redness and a peculiar tendency to bleed profusely in response to trauma (essentially such hemorrhoids are capillary nevi), and,

(b) The varicose, which represents a more or less simple dilatation and tortuosity of the superior hemorrhoidal plexus.

The appearance of the capillary hemorrhoid with tumefaction has been likened to that of a strawberry or a raspberry. The capillary hemorrhoid without tumefaction represents merely a circumscribed reddened patch on the mucosa.

The varicose internal hemorrhoid represents a mass of varicose veins within a sac of redundant and thickened mucous membrane; the size of the tumefaction thus produced is variable. Although there are characteristically five branches of the superior hemorrhoidal vein, (Miles says seven) all five of which give rise to the formation of a hemorrhoidal mass, only three characteristically do form such masses, one on the right and two on the left side of the rectal canal.

Internal hemorrhoids take origin from the portion of the rectum between the internal and external sphincters, an area much nearer the anus, (0.5 to 0.75 in.) than is sometimes supposed.

**ETIOLOGY.** The etiology of hemorrhoids is too well known to be detailed at length in this connection.

The characteristic age incidence is between twenty-five and fifty years, which represents the period of greatest physical activity in the male and the child-bearing period in the female. Males are affected somewhat more frequently than females,

and the better classes of the population slightly more often than the poorer classes.

The predisposing causes include:

1. The upright position.
2. The absence of valves in the rectal veins, and
3. The obliquity of the course of the veins in the rectal wall, in accordance with which the movement of the intestines exerts back-pressure upon the venous blood column.

According to Pennington,<sup>2</sup> the exciting cause is bacterial; the sinuses and diverticuli of the lower rectum act as culture tubes for bacteria which are able to invade either directly or by the elaboration of toxins, the walls of veins in which the flow of blood is retarded, and produce infiltration, dilatation and thrombosis.

**SYMPTOMS.** The three cardinal symptoms of hemorrhoids are (1) bleeding; (2) pain; and, (3) prolapse.

The tendency of hemorrhoids to bleed is so well known that authorities on rectal diseases frequently warn against assuming that all rectal bleeding is due to a condition of hemorrhoids. The blood is unaltered in bleeding from hemorrhoids and consequently is bright red in color; it may either streak the stools or may be passed in the form of drops or free oozing during and after the act of defecation.

Pain is most acute in the thrombotic external variety of hemorrhoids; occasionally internal hemorrhoids may prolapse through the anus and develop parital strangulation thus becoming acutely painful; but except for these two varieties the pain of hemorrhoids is usually slight, being described as a sense of fullness in the rectum, a feeling as if defecation had been incomplete, or a dull burning or aching sensation in or near the anus.

External hemorrhoids, except for the thrombotic variety, do not usually cause symptoms except because of their size; however, as previously mentioned, internal hemorrhoids, when well developed, show a tendency to become partially extruded through the anus during the act of defeca-



tion and are then appreciated as masses. The patient usually learns to replace them readily with his fingers.

**TREATMENT.** The treatment of hemorrhoids has always been, and still continues to be, a matter of controversy and difference of opinion. For obvious reasons local treatment by whatever method, can hardly be expected to result favorably in cases in which the local condition is secondary to (1) cirrhosis of the liver, (2) cardiorenal disease, (3) carcinoma or other tumors of the rectum, or (4) back-pressure by tumors either in the pelvis or abdomen.

**PALLIATIVE TREATMENT.** Ordinary palliative treatment is of relatively little value in average cases of hemorrhoids. Regulation of the bowel function, hot sitz-baths, suppositories, and ointments, though useful to some extent in cases in which radical procedures are contraindicated, cannot be expected to be of much avail in actually correcting well-developed hemorrhoidal pathology.

That certain cases of hemorrhoidal varicosities tend to undergo spontaneous resolution is well known, and that correction of associated pathology alone is frequently sufficient to effect a cure is also appreciated.

**INJECTION TREATMENT.** Although the injection treatment of hemorrhoids is recognized by some, and possibly by an increasing number of authorities as a curative form of treatment in selected cases, there is still some doubt that hemorrhoidal pathology is permanently corrected by injection methods; therefore, this form of treatment is provisionally considered as palliative rather than curative.

Devised many years ago the injection treatment has been held largely in disrepute by conservative practitioners. Of late years, awakening of interest in the curative possibilities of injection methods has been precipitated by an increasing literature on the value of such methods in the treatment of varicose veins of the lower extremities.

Mitchell of Clinton, Illinois, is sometimes given credit for having originated the injection treatment in 1871; the method has been variously called the "American system," "the absorbing treatment," and the "injection treatment."

The treatment under discussion consists of the injection of an irritant and sclerosing solution into a hemorrhoidal mass for purposes of thrombosing the blood vessels and stimulating the formation of fibrous connective tissue in order to produce obliteration of the veins, the anchoring of redundant and loose epithelium to underlying tissues, and the obliteration of the associated tumefaction by a process of slow anemic necrosis.

The injection of a sufficient amount of caustic solution to produce rapid necrosis and sloughing is a variation of the injection method which is almost universally recognized as irrational and dangerous, and this procedure has gone far to bring the injection treatment as a whole into disrepute.

It may be repeated that the desired mechanism is only the production of a thrombophlebitis accompanied by local irritation, the formation of plastic exudation, and obliteration of the diseased area by shrinkage and atrophy of the tissue, in the absence of ulceration.

The type of hemorrhoids most suitable for the injection treatment is the uncomplicated internal variety. Such hemorrhoids may or may not prolapse through the anus; but when they do they are easily replaced. Bleeding from this type of hemorrhoid is frequent. The injection treatment promptly obviates the hemorrhage.

A very few authorities advise the injection treatment for certain interno-external hemorrhoids.

The external variety is universally considered unsuitable.

Many different solutions have been advocated for purposes of injection, but only two have yet attained any considerable amount of popular favor; (a) phenol in glycerine or olive oil in solutions of 5

or 10 per cent strength, and (b) 5 per cent solutions of quinine and urea hydrochloride.

In the case of phenol-in-glycerine or olive oil injections the method consists in injecting 10 to 20 minims of the solution directly into the middle of a selected hemorrhoidal mass. The amount is not arbitrary, but is gauged by the appearance of the injected area; when the first sign of blanching appears the injection should be discontinued.

The advantages claimed for quinine and urea hydrochloride are (1) comparative safety; (2) freedom from slough; and (3) absence of pain. About 1 c.c. of this solution is injected directly into the middle of the hemorrhoidal mass, and more than one mass may be injected at a time. Several injections at intervals of a week or somewhat less are usually required to produce satisfactory fibrosis and shrinking.

The following constitute the common contraindications to the injection treatment: (1) infection; (2) spastic sphincter; and (3) complications such as fissures, ulcers, and external hemorrhoids.

The injection method has been advocated for use in selected cases by a number of different authorities, amongst whom may be mentioned Tuttle, Hill,<sup>3</sup> Martin,<sup>4</sup> Albright, Terrell,<sup>5</sup> Landsman,<sup>6</sup> Hirschman,<sup>7</sup> and many others. However, as previously stated, it is not universally agreed that the injection treatment is permanently curative, and in the judgment of many surgeons the method is still too much under the cloud of suspicion previously cast upon it by irregular and unreliable practitioners.

Representative of the radical wing of the profession, E. H. Terrell,<sup>5</sup> of Richmond, Virginia, who introduced quinine and urea hydrochloride as a sclerosing solution for hemorrhoids, has used the injection method in between 4000 and 5000 cases, and asserts emphatically that though suitable only in about 50 per cent of cases, the method is capable of producing absolute cures.

As a representative of the conservative group, A. A. Landsman,<sup>6</sup> however, believes that whereas the method is not without

value as a palliative procedure in the treatment of bleeding hemorrhoids, it is in no sense curative and that all patients so treated invariably have a recurrence of the primary condition within a period of a few months. He also states that it is a dangerous method in that it is capable of producing sloughs of the rectum.

**RADICAL TREATMENT.** The radical treatment of hemorrhoids consists of surgical removal.

*Indications:* Surgical removal is a method applicable to the treatment of all three varieties of hemorrhoids, (1) internal; (2) interno-external, and (3) external. Especial indications for surgical treatment are recognized: (1) when the hemorrhoids are infected or acutely inflamed and (2) in the presence of some other adjacent condition amenable only to surgery, such as fistulae, fissures, and polyps.

**ANESTHESIA.** General anesthesia may be indicated in special cases, but is rarely necessary or desirable. Sacral anesthesia is the method of choice in most cases:

1. It is eminently safe;
2. The operative field is undistorted;
3. Sphincteric relaxation is complete;
4. The patient, being conscious, can cooperate in various manipulations if desired;
5. Sensation returns slowly, and thus postoperative pain is minimized.

Under ordinary circumstances spinal anesthesia is believed to be too radical a method for use in so simple a procedure.

Local anesthesia is sometimes used, but is undesirable because its use distorts the parts to be operated upon and predisposes to the development of infection and regional traumatic thrombophlebitis.

**OPERATIVE TECHNIC.** The treatment of thrombotic external hemorrhoids consists in making a small incision over the hemorrhoid and evacuating its contents; this is usually an informal operation. External hemorrhoids are best removed by ordinary excision with the scalpel, any oozing that may result being controlled by the use of ligatures.

Of all the methods of performing the removal of internal hemorrhoids which have been devised, there is none which can be regarded as ideal. The method which perhaps gives the best results in the hands of the greatest number of surgeons is the classical method of clamp and cautery excision.

CLAMP AND CAUTERY EXCISION. In outline the operative technic is as follows:

1. The bowels having been regulated for a day or two previously and the lower intestinal tract having been thoroughly cleansed by means of bland enemata, the patient is placed in dorsal decubitus upon the operating table, the legs are lifted and fastened to legholders and the body of the patient is drawn well down over the edge of the table so as thoroughly to expose the anus and perineum.

2. The rectum and anus cannot be sterilized by any known method, and consequently the sole aim of the local preparation is macroscopical cleanliness: this is best achieved by thoroughly douching the perineum first with soapsuds and then with sterile water, the gloved finger being introduced into the rectum during the process and being manipulated so as, on the one hand to permit the entrance of the cleansing liquid into the rectum, and on the other hand, to aid in dislodging and removing any gross particles of feces which may have escaped the action of previous enemata.

3. The patient is draped.

4. Gentle dilatation of the sphincter is next performed, unless the sphincter is unusually relaxed, as it may occasionally be especially in women with relaxed perineum and in patients in whom sacral anesthesia has been performed. Care must be exercised during the process of dilatation, (a) that the concomitant nervous stimulation does not cause the patient to inhale an overdose, or even a lethal dose, of the anesthetic if a general anesthetic is used, as has sometimes happened when general anesthesia has been thoughtlessly given and, (b) that neither rupture nor

undue distention of the sphincter is produced, so that the tone and contractile power of the sphincter are permanently abolished. For purposes of dilatation no instruments are better than the fingers or thumbs. When dilatation is complete the entire pile-bearing area is readily brought into full view.

5. Any internal hemorrhoids that may be present are recognized and are dealt with one mass at a time. The mass is first caught at either end with a pair of Allis or other suitable clamps, so as to lift the hemorrhoid away from the rectal wall and expose its pedicle. A sturdily constructed hemorrhoidal clamp is now passed upward, one jaw along either side of the pedicle and the jaws are then brought together and tightened so as to crush the extreme base of the hemorrhoidal mass.

6. Wet compresses or moistened pieces of asbestos are now carefully placed between the under surface of the hemorrhoid clamp and the mucous membrane of the rectum to prevent subsequent burning of the rectal mucosa. This should be done even though the jaws of the clamp are ivory-faced, for burns of the mucosa in this region are both painful and capable of producing disastrous cicatricial contractures.

7. With the actual cautery heated to a dull red heat the entire hemorrhoid is now burned away flush with the upper surface of the hemorrhoid clamp, and the clamp is cautiously loosened and removed.

If any bleeding results it must be controlled by ligature.

8. No dressing is required other than a suitable perineal binder. The use of the rectal plug is rapidly falling into disfavor.

Postoperatively no local treatment is usually required except a carefully given olive oil enema on the second or third postoperative day. Care is taken to assure the passage of liquid stools by administering suitable doses of liquid petrolatum beginning on the evening of the second day. In cases in which local pain becomes severe there is no treatment which sur-

passes hot sitz-baths, and these may be given within thirty-six to forty-eight hours postoperatively if desired.

**PENNINGTON TECHNIC.** The technic which from both theoretical and practical viewpoints seems most meritorious is that developed and advocated by Pennington. Pennington's procedure even when performed by a skillful surgeon rarely impresses a person seeing it for the first time very favorably because (1) hemorrhage is usually profuse, and (2) minutiae of manipulation must frequently be modified in accordance with the individual peculiarities presented by any given case, so that unless one is familiar with the principles underlying the method the rationale of the necessary minor variations in technic is not readily apparent. Furthermore, some considerable practice with the method is necessary before either the best end-results can be obtained or the distinct superiority of the procedure with respect to postoperative convalescence can be thoroughly appreciated. To the surgeon willing to spend a little time developing the technic and not averse to sacrificing esthetic appearances in the operating room on the altar of end-results, the Pennington procedure offers a considerable reward.

The patient is prepared in precisely the same manner as when the clamp and cautery technic is used up to and including dilatation of the sphincters. The actual removal of the hemorrhoidal masses is performed as follows: At the mucocutaneous junction just proximal to each hemorrhoid, a special pile-clamp is placed; this clamp presents the general appearance of a sponge holder except that it is made with a triangular instead of an ovoid fenestrum: the base of the triangular fenestrum grasps the tissue. With the clamp as a lever the hemorrhoidal mass is now dislocated outward over the end of the gloved finger as a fulcrum, and a ribbon of mucous membrane is excised with scissors from the most protuberant portion of the mass, so planning the incision that its long axis corresponds with

the long axis of the bowel. In favorable cases an exaggeration of the movement previously made in dislocating the hemorrhoidal mass outward now forces the mass of veins through the rent in the mucous membrane, and the entire hemorrhoidal mass can be clipped away with a single motion of the scissors. Usually however some slight dissection with the points of the scissors is necessary to free the mass of dilated and tortuous veins completely. Unless the hemorrhoidal veins are completely thrombosed a rather free hemorrhage is to be expected, and when necessary, forcipressure and ligature are used to control this. Care should be taken during all these manipulations to avoid tearing the mucocutaneous margin as a result of too vigorous traction on the clamps. The various masses are treated seriatim in this manner, and the pile clamps are removed.

The rectum now presents itself as a tube lined with mucous membrane except for the longitudinal slits through which the hemorrhoidal masses were previously removed. A specially shaped rectal plug is now inserted into the rectum for a period of eight to twelve hours in order to control hemorrhage and to spread the slits in the mucous membrane. The plug is fashioned of gauze strips wound on a large rectal tube and covered with rubber tissue. The shape of the plug corresponds with that of a pear through which a tubular corer has been forced. The rectal tube corresponds with the corer; the end of the tube at the small end of the pear-shaped plug is inserted into the rectum, and the plug is pushed up against the perineum where it is permanently held by means of a perineal binder. It must be understood that only the small end of the pear shaped plug enters the rectum, the larger end merely resting against the perineum, so that the rectal tube is left patent to allow for the expulsion of gas, and the portion of rectal tube actually lying within the rectum is only 2 or 3 in. in length.

The rationale of the procedure depends

upon the assumption that all internal hemorrhoids represent essentially infected tissue. For this reason it is irrational to expect primary union after the removal of the hemorrhoidal masses. No attempt is therefore made to sterilize the various operative areas either by heat or chemicals, and subsequently, mechanical means are used to spread the lips of the incision through which the hemorrhoids have been removed, i.e. the rectal plug. In other words, in effect the treatment is similar to that which would be employed in the treatment of small abscesses; the free incision with a sharp instrument, evacuation of infected tissue, and the adoption of a mechanical measure to keep the area open and thus favor granulation from the bottom.

The after-treatment of cases treated by the Pennington technic consists of removal of the rectal plug at the end of the prescribed time, regular administration of mineral oil beginning on the morning of the second postoperative day in order to ensure the free passage of liquid stools, and the early adoption of a regime of frequent warm sitz-baths to ensure mechanical cleansing of the operative area.

Because of the fact that no considerable portion of the rectal mucosa is removed at the time of the original operation no fear of subsequent stricture formation need be entertained.

Patients treated thus will be found to develop little local reactionary edema, and healing progresses in the absence of any considerable degree of pain because free drainage is provided for the products of suppuration.

**THE WHITEHEAD PROCEDURE.** There is one operation for hemorrhoids which should rarely, if ever, be performed, the so-called Whitehead operation. It consists of (1) the excision of the entire pile-bearing segment of the mucous membrane, together with its associated hemorrhoids, and (2) the immediate suturing of the edge of the divided mucous membrane to the edge of the skin.

A more or less typical deformity too frequently follows the performance of this operation, consisting of a skin stricture at the anal margin through which loose ampullar mucosa prolapses; the mucosa undergoes ulceration and bleeds profusely. The alleviation of this secondary pathology is often far more troublesome and difficult than the relief of the original condition. It is for this reason that the Whitehead procedure has fallen into almost absolute disrepute. Lockhart-Mummery said at the London meeting of the American Proctologic Society, in 1924, that the gathering would have been successful if it had done nothing beyond sounding the deathknell of the Whitehead operation.

#### ABSCESSSES ABOUT THE RECTUM

Lockhart-Mummery has said, "abscesses in the perianal region are not at all uncommon, and may occur in a great variety of forms, and as the result of many different conditions." Except in relation to their situation, they differ in no important particular from abscesses in other situations. They are chiefly important because they very frequently result in the formation of fistulae.<sup>8</sup>

**ETIOLOGY.** The primary factors in the etiology of abscesses about the rectum are trauma and infection.

1. *Trauma:* Even minute abrasions or ruptures in the continuity of the anal skin or rectal mucous membrane may serve as portals of entry for bacteria. The mere stretching of the region may be sufficient to produce the necessary trauma; foreign bodies, and occasionally surgical procedures, may be responsible.

2. *Infection:* Staphylococci are the most common bacteria found in abscesses about the rectum, and are generally considered as the primary invaders. The colon bacillus is only slightly less frequently recovered, but because of the proximity of the intestinal lumen, which is constantly teeming with these organisms, the presence of the colon bacillus can be easily explained on the basis of secondary invasion. The

rôle of the tubercle bacillus in the production of perirectal abscesses is a matter of keen dispute amongst proctologists. Equally good authority can be cited for the opinion that by far the greater percentage of these abscesses is tuberculous as for the reverse opinion. The subject will be discussed more at length in connection with fistulae, which characteristically occur as an end result, especially of certain varieties of perirectal abscesses.

*Varieties:* The classification of abscesses about the rectum is purely anatomical; they may be divided conveniently into three groups:

1. Perianal;
2. Perirectal;
3. Ischiorectal.

Perianal abscesses are of two varieties (1) the intracutaneous, and (2) the subcutaneous.

#### INTRACUTANEOUS PERIANAL ABSCESES

Abscesses within the perianal skin are similar to skin abscesses elsewhere. They may be of the nature of furuncles or carbuncles. Predisposition to the occurrence of such lesions is caused by the presence of irritating discharges from the anus or vagina, friction, sweating, and uncleanness.

#### SUBCUTANEOUS PERIANAL ABSCESES (MARGINAL ABSCESS)

The subcutaneous abscess is the most frequent type; such abscesses characteristically occur below the skin at the mucocutaneous junction, develop rather rapidly and may burrow more or less widely. Symptoms may be mild or severe depending on the extent of the lesion. In the more widespread lesions the onset may be characterized within twenty-four to forty-eight hours by fever and chills, and pain, both localized and radiating to the bladder and down the thighs. The position assumed by the patient is characteristic in that he avoids sitting flat on a chair. The diagnosis may sometimes be impossible on inspection: only when the

finger is introduced into the rectum may the diagnostic signs of swelling and tenderness be elicited.

#### THE PERIRECTAL OR SUBMUCOUS RECTAL ABSCESES (INTRAMURAL ABSCESS)

The submucous or perirectal abscess occurs just below the mucosal lining of the rectum and is similar in its clinical manifestations to the variety just previously mentioned. The diagnosis in this variety, however, is never possible in the absence of digital examination per rectum.

#### ISCHIORECTAL ABSCESS

Abscesses about the anus and rectum were formerly all called ischiorectal abscesses; but as now used the term refers only to abscesses within the ischiorectal space or fossa which is formed *laterally* by the ischium and the overlying obturator internus muscle, *medially* by the skin, *anteriorly* by the triangular ligament, and *posteriorly* by the border of the gluteus maximus muscle.

Abscesses in this region are apt to be of a serious nature. They may attain large proportions. Although they usually form rapidly they may attain sufficient proportions to cause disturbing symptoms only after the lapse of several weeks or even months.

The symptoms are either acute or subacute corresponding with the mode of development.

In the acute type local pain is severe; it may radiate to the sacrum or down the thigh and leg; it is characteristically throbbing and burning in character. The local signs of inflammation often do not appear superficially for some days even though the onset is acute; the classical signs of inflammation may, however, be recognized by rectal examination during this period. Induration, redness, and swelling, often diffuse and involving the entire ischio-rectal cutaneous region, give evidence that the abscess is pointing toward the skin.

Ischiorectal abscesses on one side of the rectum may work their way to the opposite side by way of the posterior commissure, less commonly by way of the anterior commissure. They occasionally dissect upward into the pelvis and may even follow Colles' fascia around to the inguinal ligament.

**TREATMENT.** Left to themselves abscesses about the rectum tend to rupture either into the rectum or onto contiguous skin surfaces.

The treatment of abscesses about the rectum is purely surgical and consists, as in cases of abscesses in other locations, of incision and drainage. Because of the location of rectal abscesses, however, secondary contamination always occurs, healing is frequently long delayed, and sinuses and fistulae are prone to develop.

In planning incisions for the drainage of ischiorectal abscesses it is well to open the rectal mucosa longitudinally to avoid stricture formation, and to open the skin radially. Abscesses should be thoroughly packed with gauze to enforce healing from the bottom, and should be kept as clean as possible to lessen secondary infection.

#### ANAL SINUS AND FISTULA

Anal sinuses and fistulae represent the end-results of neglected, improperly treated, or inadequately treated perirectal abscesses.

When the abscess ruptures through overlying tissues to the surface of the skin an external sinus is formed; when the rupture occurs through the mucous membrane lining the rectal tube, the opening thus formed is known as an internal sinus.

A fistula is formed when rupture occurs both onto the skin surface and also onto the mucous membrane of the rectum, so that a communicating and suppurating tract connects the interior of the rectum with the external skin; or, when a suppurating tract is formed in a similar manner having two or more openings on the skin, two or more openings on the mucous membrane, or any combination of these.

The mucosal openings of both sinuses and fistulae frequently occur at the mucocutaneous line, between the external and internal sphincters, and are more apt to be found posteriorly than anteriorly and laterally; such openings, however, are also found above the internal sphincter and sometimes, though rarely, below the external sphincter.

Fistulous tracts with small openings, which later tend to become occluded with granulation tissue, usually represent the pathology of recurrent perirectal abscesses and multiple sinuses. The closure of the fistulous opening favors exaltation of the virulence of residual organisms, an acute abscess develops, and subsequent rupture through a new cutaneous or mucous area produces a new fistula.

The sinuses and fistulae which result from ordinary pyogenic perirectal abscesses represent merely a chronic suppurative condition which is incident to failure of the original lesion to granulate properly from the bottom. Abscesses in this region are prevented from granulating properly because of their location. The natural movements of the anus and rectum in expelling gas and feces and the contractions and relaxations of the sphincters in connection with these acts exert traction on the suppurating surfaces and interfere with the rest needed by the inflamed areas during the process of repair. In addition to this, mucus and feces at frequent intervals are squeezed into the inflamed area by the bowel movements with the resultant production of additional infection and trauma.

**SYMPTOMS.** The symptoms are those of perirectal abscess followed by a prolonged period in which there is a sense of irritation or itching in the perianal region, pain during defecation, and the presence of a mucoid or a purulent discharge, often blood-tinged. The discharge may be more or less continuous in type or intermittent, depending upon whether the fistulous opening remains open or alternately opens and closes; in the latter case exacerbations



and remissions of local symptoms of inflammation may occur.

**TYPES OF FISTULA.** Three general types of fistula-in-ano are recognized of which the first two are, properly speaking, sinuses and not fistulae: (1) the blind internal fistula which opens on the mucous membrane: (2) the blind external fistula, which opens on the skin, and (3) the combined internal and external fistula which opens both onto the skin and onto the mucous membrane.

As previously noted, however, true fistulae result when either type, one or two, i.e. either the internal or the external variety presents more than one opening.

The interno-external type of fistula is often subdivided into subvarieties such as (a) multiple, or branching, (b) Y-shaped, (c) horseshoe-shaped.

**TREATMENT.** The treatment is surgical and consists, in the pyogenic type of fistula, in passing a probe into the tract and excising the entire tract when possible. If complete excision is impossible cauterization of the tract after thorough curettage may be tried. Thorough dilatation of the sphincters is necessary in most and is desirable in all cases. The fistulous tract is packed open and forced to heal from the bottom. If the external sphincter must be divided it is to be divided in only one place. Subsequent division at another place is permissible only after the original incision has thoroughly healed.

That anal sinuses and fistulae are often resistant to treatment is generally recognized, and the fact that some of them have been demonstrated to be tuberculous has led to the very serious consideration of the general relationship of the tubercle bacillus to these lesions.

Probably as much difference of opinion exists with regard to the etiological relationship of bacillus tuberculosis to fistula-in-ano as exists with respect to any subject in surgery.

Buie<sup>9</sup> states that estimations of the relative frequency of tuberculous fistula to non-tuberculous fistula range all the way

from 2 to 90 per cent and Fansler<sup>10</sup> gives the range as between 1.4 per cent and 70 per cent.

It is generally believed that fistula-in-ano is especially apt to occur in patients with pulmonary tuberculosis. However, such figures as are available hardly support such a hypothesis, and besides, if the incidence of fistula-in-ano were actually higher than it is, the tuberculous character of such fistulae would not be proved, for tuberculous patients present other characteristics tending toward the production of such a condition, a generally run-down physical condition, many patients being actually bedridden, and a large number because of constipation incident to lack of exercise being required to use cathartics and enemas to excess.

In the following table a résumé of representative opinions is expressed in the form of percentages.

Author	Per Cent of All Rectal Fistulae Tuberculous	Per Cent of Patients with Fistula Having Pulmonary Tuberculosis	Per Cent of All Tuberculous Patients Having Tuberculous Fistulae
Andreal.....	....	14.7	.....
Gant.....	10	.....	.....
Hartman.....	50	10-14	5
Dudley (72 cases).....	....	1.4	.....
Walsham (891 cases)...	....	.....	.56
Thoss.....	5.5 (by histological examination)	11.0 (by physical findings)	.....
Gabriel (75 cases).....	20	.....	.....
Pennington (701 cases)...	14	.....	.....
Allingham.....	14	.....	.....
Stone.....	10	42	.....
Fansler.....	23	....	0.33

Fansler<sup>20</sup> has presented certain actuarial statistics showing that the mortality rate is normal in persons with anal fistula if the body weight of such persons is above normal, but that in persons 15 per cent under weight who present anal fistula the mortality rate is increased to 134 per cent. This he interprets as an indication of a correla-



tion between pulmonary tuberculosis and rectal tuberculosis, but the logic is not impeccable.

Such discrepancies of opinion as those just previously noted, can occur only in cases in which criteria for accurate diagnosis are lacking. In the case of the suspected tuberculous fistula to rely upon the physical findings for the elucidation of the etiology is merely to hazard a guess. The only two rational criteria for judgment are (1) the finding of typical tubercles in pieces of tissue removed at biopsy and (2) the recovery of the tubercle bacillus from the lesion (either by simple smear or by animal inoculations).

In making use of the second procedure, two special pitfalls must be avoided: (1) no other focus of infection must be present in the gastrointestinal or respiratory tract higher up, from which the tubercle bacilli could have been derived; (2) other acid-fast bacilli, especially the smegma bacillus, must not be confused with Koch's bacillus. That the entire question is in need of accurate scientific and careful statistical bacterial study must be recognized.

In the treatment of sinuses and fistulae known to be, or strongly suspected of being, tuberculous, it has been suggested that general anesthesia be avoided and that cautery excision be substituted for excision with the scalpel. Chisholm<sup>21</sup> has recently reported a series of 22 cases of proven tuberculous sinus treated by this method with very favorable results. Healing has invariably occurred in from six weeks to three months.

Smith<sup>22</sup> has advocated a combination of ultra-violet light therapy with surgical treatment; he uses the water-cooled quartz-mercury generator.

#### FISSURE OF THE ANUS

Simple anal fissures are rents in the mucocutaneous lining of the anal canal, and according to Yeomans<sup>23</sup> constitute about 8 per cent of all rectal diseases.

They may be very superficial, on the one hand, or extend as deep as the internal

sphincter muscle on the other. A skin-tab frequently develops at the outer end of the fissure, the "sentinel pile of Brodie" which, when present is pathognomonic of fissure.

**ETIOLOGY.** These lesions are less common in children and the aged than they are in middle life.

**EXCITING CAUSES.** The exciting causes of fissure in ano are trauma and infection; the trauma may be dependent upon one or another of many factors such as the

1. Passage of a scybalous fecal mass,
2. Clumsiness in the use of a syringe tip,
3. Unskilled prostatic massage and,
4. The stretching of the pelvic outlet during parturition.

Not infrequently fissure in ano represents abscess formation in one of the sinuses of Morgagni.

**SYMPTOMS.** The characteristic symptoms are two in number: (1) pain, which is exquisite during and immediately after defecation and which persists for several minutes or even hours as a dull, burning, aching, or throbbing pain, and (2) blood streaking of the stool or the passage of a few drops of bright red blood.

Occasionally reflex symptoms may be prominent such as dysmenorrhea, dysuria, or retention of urine, and pains referred to the ilio-lumbar or sciatic nerves.

Anal fistulae are more apt to be found in the posterior commissure in men, and in the anterior commissure in women.

**TREATMENT.** The treatment consists in thorough dilatation of the sphincters, excision of the fissure and packing of the traumatized area with a small wick of gauze. Postoperative attention is required to keep the bowel movements liquid until complete granulation of the wound from the bottom has occurred.

#### PRURITUS ANI

Pruritus ani, in spite of a considerable number of investigations, remains more or less of an enigma. It has been universally appreciated that various local lesions are capable of causing the condition and that when these sources of irritation are eradi-

cated the pruritus disappears; the pruritus associated with diabetes and certain other systemic diseases is well known, and the treatment for such pruritus is obvious. A generally unappreciated source of pruritus is suggested by Terrell and Vaughn<sup>24</sup> who in 1925 tested 25 patients with pruritus ani for food protein sensitization and found five who reacted positively and who were relieved by avoiding the sensitizing food substance.

**ETIOLOGY.** The etiology may be conveniently classified as follows:

1. Pruritus secondary to:

(a) Systemic diseases, especially diabetes, diseases complicated by jaundice, and food sensitizations.

(b) Local infections, such as fistula, fissure and mycotic invasions.

2. Idiopathic pruritus.

**TREATMENT.** The treatment for the varieties of pruritus secondary to systemic diseases or local infections is sufficiently obvious. The administration of massive doses of iodides (60-300 grains, t.i.d.) is sometimes efficacious in the treatment of mycotic infections.

In the idiopathic variety of pruritus surgical treatment is satisfactory and consists of a wide undercutting of the perianal skin, the so-called undercutting operation or subcutaneous neurotomy of Ball. This operation simply severs the nerve supply to the perianal skin, thus producing a local anesthesia.

#### STRICTURE OF THE RECTUM (NON-MALIGNANT)

Non-malignant strictures of the rectum may be classified both with respect to form and also with respect to etiology.

Structurally there may be described four varieties of lesions (according to Drueck):<sup>25</sup>

1. The annular, which is circular and narrow.

2. The tubular, which is circular and broad.

3. The linear which is non-circular.

4. The valvular which represent hypertrophy of Houston's valves.

*Etiologically* true strictures may be due to:

1. Developmental anomalies.
2. Trauma.
3. Inflammatory processes.

A. non-specific

B. specific

(a) syphilis

(b) gonorrhea

(c) tuberculosis

(d) dysentery

1. **STRICTURE DUE TO DEVELOPMENTAL ANOMALIES.** This type of stricture has previously been described and usually represents a defect at the junction between the proctodeum and the hindgut representing incomplete cannularization of the intestinal lumen at this point; such strictures are located 1-1½ in. above the anus and consist of a band or fold.

Congenital strictures frequently give rise to few or no symptoms till about the age of puberty. It is supposed that at this period of life, changes in habits and dietary digressions may initiate symptoms, emphasizing a degree of mechanical obstruction previously insignificant.

2. **TRAUMATIC STRICTURES** arise as the result of:

(a) The application of strong caustics to the rectal mucosa, e.g. silver nitrate and zinc chloride.

(b) Surgical resection of the rectum with subsequent end-to-end anastomosis. This operation is almost invariably followed by stricture formation.

(c) Childbirth and extrarectal operations, notably gynecological procedures which may interfere with the blood supply to the rectum, especially in producing thrombosis of a branch of the middle hemorrhoidal artery.

3. **STRICTURE DUE TO INFLAMMATORY PROCESSES.** Various inflammatory reactions, both of a specific and non-specific nature are known to produce strictures of the rectum.

Stricture formation does not occur in those cases in which the mucosa of the rectum alone is involved. The mucous lining of the intestine is capable of very wide-

spread and complete regeneration after injury.

Lesions occurring in the submucosa, on the other hand, are prone to undergo repair by a process of fibrosis. The subsequent contraction of the fibrotic connective tissue is responsible under these conditions for the production of a stricture.

#### A. *Non-specific Inflammation:*

(a) Neglect of fistulae may result in rectal stricture just above the internal opening.

(b) *Persigmoiditis* and *diverticulitis*.

(c) *Peritonitis* and *pelvic cellulitis* indirectly by the production of bands of adhesions which in turn may produce angulation of the bowel, and atrophy of the circular muscle fibers.

(d) *Inflammatory extensions* from abscesses arising in the prostate of the male and the broad ligaments in the female.

B. *Specific Inflammatory Strictures.* *Gonorrheal Stricture.* That the gonococcus is capable of invading the rectum and initiating a proctitis is common knowledge, but it is questionable whether stricture formation frequently results therefrom, because one of the well-established characteristics of the gonococcus is that it lives on mucous surfaces and does not tend to invade submucous tissues. However, the rectum provides glandular openings, as does the urethra, and the development of rectal stricture by a mechanism similar to that involved in the production of urethral stricture is a possibility.

*Syphilitic Stricture.* The etiological importance of lues in the formation of rectal strictures is almost universally recognized. Yeomans<sup>26</sup> found unmistakable evidences of lues in 80 per cent of his cases. Drucek,<sup>25</sup> however, has not had the same experience, many of his cases having shown neither a positive complement-fixation test nor a positive clinical history.

Both chancres and mucous patches occur in the rectum and both involve structures below the mucosa. The microscopic changes found in syphilitic stricture consist of the formation of gummatous nodules around

the blood vessels and end-arteritis encroaching upon their lumina.

*Tuberculous Stricture.* Primary tuberculous lesions in the rectum are universally admitted to occur but rarely. In those cases in which strictures have been proved tuberculous, either quiescent or active foci of infection are usually to be found in the lungs.

Tuberculosis of the rectum represents most frequently a distinctive lesion in which sloughing of tissue is the fundamental pathology. Only rarely does the tubercle bacillus produce a fundamentally proliferative process with scar tissue contraction and stricture formation. Such pathology is more characteristic of carcinoma and diverticulitis, and the correct diagnosis is not often made clinically for that reason.

*Dysenteric Stricture.* Dysenteric stricture, though a possibility, is probably of very infrequent occurrence.

**PROCTOSCOPIC CHARACTERISTICS OF BENIGN STRICTURE.** Benign strictures usually occur from 2 to 6 in. above the anus. The rectum from the anus to the stricture is of the shape of a truncated cone, the truncation representing the stricture. Unless ulcerated, the mucosa over the stricture is apt to be of a bluish-white appearance, has lost its shining luster, and characteristically appears dry. Its appearance corresponds roughly with that of a healed burn of the skin. The microscopic change represented is one from columnar to pavement epithelium. To the touch it feels dense and hard. The surface of the stricture itself rarely undergoes ulceration.

Ulcerating areas above the site of stricture are usually resultant upon the irritant action of retained fecal material. Ulcerations below the site of stricture, on the other hand, commonly represent a process of necrosis secondary to interference with the local blood supply by the abnormal processes above.

Ulcerations in the neighborhood of strictures, whether above or below the site of stricture, tend to undergo a process

of reactionary edema and incite granulation tissue formation, both of which combine still further to exaggerate the stenosis of the gut.

**TREATMENT.** Non-malignant strictures of the rectum are of little importance surgically except from the point of view of excluding malignancy. The treatment of these strictures is the treatment of the disease to which they are secondary, supplemented by palliative colostomy in the most acute cases and graduated dilatations of the stricture at intervals of several days in the ordinary forms of the disease.

#### SARCOMA OF THE RECTUM

Sarcoma of the rectum is a very rare condition. Weeks<sup>27</sup> in 1927 was able to collect only 100 cases from the literature. He calculates that 1 case of rectal sarcoma occurs to every 242 sarcomas found elsewhere, and that 1 sarcoma occurs in the rectum for every 199 rectal carcinomata.

Sarcomata of the rectum occur five times as frequently in the male as in the female.

The reported cases range according to the age of the patient between thirty-five and eighty-one years.

Sarcomata of the rectum are highly vascular neoplasia which originate in the submucous, muscular, or subserous coats of the bowel, especially the submucous area. They are usually hard in consistency, unless ulcerated, and are often pedunculated, in which case the ulceration characteristically occurs at the summit of the growth.

The *diagnosis* is seldom made preoperatively; the usual diagnosis is carcinoma. Less frequently they are confused with tuberculous and gummatous lesions and with hemorrhoids.

**POSITION.** These tumors characteristically occur just above the anal opening.

**CHARACTERISTICS.** The mucosa slides freely over the growth even when the latter is relatively large. The inguinal glands are never enlarged. Cachexia is

never so pronounced in sarcoma as in carcinoma.

They do not tend to ulcerate early as do carcinomata.

The infiltrating form is differentiated from luetic strictures by complement-fixation and therapeutic tests.

**TREATMENT.** X-ray and radium are valueless, and the radical treatment differs in no essential features from that of carcinoma.

#### THE RECTAL SHELF

The clinical entity described classically by Blumer<sup>28</sup> in 1909 as the rectal shelf is a mass of metastatic tissue which occurs in the pouch of Douglas in the female, and in the rectovesical pouch in the male, and which projects into the rectum at a point corresponding approximately to the limit of palpability of the examining finger on the anterior wall of the rectum. Metastasis in this area represents presumably, in most instances, a process of seeding from a primary focus of malignancy elsewhere, more particularly in the stomach, detached cancer cells finding their way by gravity to the most dependent part of the abdominal cavity. Occasionally the rectal shelf may represent a conglomerated mass of tubercles occurring in connection with tuberculous peritonitis, or more rarely still direct extension of a tumor mass upward from the uterus in the female or the prostate in the male.

The metastatic growth has a characteristic cartilaginous "feel" and frequently is not confined to the anterior part of the rectal wall but may completely surround the bowel becoming thinner posteriorly, thus roughly simulating the shape of a signet ring. The anterior part of the growth is the most protuberant and is called the shelf. There may or may not be ulceration over the most protuberant part of the shelf.

As far as the present discussion is concerned the rectal shelf is important as a possible source of confusion in the diagnosis of carcinoma of the rectum; unless the occurrence of this particular type of tumor

in the wall of the rectum is borne in mind one is apt to diagnose erroneously primary rectal carcinoma and incidentally to miss the significance of the mass in its relation to the true condition.

#### PROLAPSE OF THE RECTUM

**ETIOLOGY.** Prolapse of the rectum is a disease primarily of children; over 60 per cent of the cases collected by Napalkow occurred in children between one and three years of age.

The condition may, however, be encountered at any period of life and is of not very infrequent occurrence in old age.

As predisposing causes general muscular atonia, increased intra-abdominal pressure from various causes, chronic diarrhea, and diminution of the normal concavity of the sacrum are considered of importance.

**VARIETIES.** Rectal prolapse is described in three fundamental varieties:

1. Muscosal prolapse, which is the most frequent type and in which there protrudes through the external sphincter of the anus mucosa unaccompanied by the muscular layers of the rectum.

2. Complete prolapse, in which all the structures entering into the formation of the wall of the rectum protrude through the anus, and

3. Intussusception of the pelvic colon.

**SYMPTOMS AND SIGNS.** In uncomplicated cases the symptoms and signs of rectal prolapse are merely those of a regional tumor. The tumor may alternately appear and disappear, the protrusion occurring particularly as a result of a bowel movement, during exercise, or when the patient is physically fatigued. Excoriation and ulceration of the prolapsing mass may give rise to bleeding, excess mucous formation, and pain. If strangulation occurs the pain may become acute, and gangrene, with infection, may supervene.

**TREATMENT OF MUCOSAL PROLAPSE.** The treatment of mucosal prolapse in children is mainly conservative, since the condition tends to undergo spontaneous resolution. Regulation of the bowels to insure

one soft bowel movement during the course of twenty-four hours, the avoidance of straining at the stool, the immediate replacement of the prolapsed mucosa, and the maintenance of a recumbent position for at least fifteen minutes immediately thereafter, will usually suffice, if this form of treatment be sufficiently persistent.

Operative intervention in cases of mucosal prolapse is indicated when the prolapse cannot be reduced and also when it is associated with hemorrhoids in old and emaciated persons. Simple removal of redundant mucosa will suffice in certain cases; formal removal of the entire cuff of mucous membrane after the manner of the Whitehead operation will be required in others.

**TREATMENT OF COMPLETE PROLAPSE AND INTUSSUSCEPTION OF THE PELVIC COLON.** In cases of intussusception of the pelvic colon and in exaggerated cases of complete prolapse an intra-abdominal operation may be necessary; this consists of obliteration of the cul-de-sac of Douglas (or the rectovesical pouch in the male) and mobilization and suture of the pelvic colon to the psoas minor tendon.

In less well-developed cases intra-abdominal manipulations are not required and either the operation devised independently by Rehn and Delorme or, even more simply, a modified perineorrhaphy is frequently successful.

#### BENIGN NEOPLASIA

The common benign neoplasia of the rectum are (1) fibrous polypi, (2) adenomata, and (3) papillomata.

*Fibrous polypi* occur most frequently at the mucocutaneous margin; they are composed of a connective tissue stroma covered by squamous-celled epithelium. They vary in size from that of a small pea to that of a small egg. Symptoms caused by these tumors are purely mechanical and when removed by clamp and cautery they do not tend to recur.

*Benign adenomata* of the rectum may

occur at any point on the mucosa of the rectum, or, for that matter, anywhere on the mucosa of the bowel cephalad to the rectum. When occurring in the lowermost part of the rectum they may be recognized by digital examination; when they occur beyond the reach of the examining finger they are recognized only by protoscopic or sigmoidoscopic examination. They may be single or multiple, may range in size up to that of a walnut and in appearance may vary between that of the normal mucous membrane and a finely lobulated and reddened appearance like that of a raspberry. They are pedunculated. Unless the pedicle is sufficiently long to permit the tumor to protrude from the rectum, the only symptom which may be present is hemorrhage either at stool or between bowel movements.

The treatment of adenoma is complete

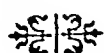
clamp and cautery excision if the tumor is placed sufficiently low; otherwise, fulguration. Recurrences are rare.

*Papillomata* of the rectum are lobulated or villous tumors which are soft and sponge-like in consistency, red in color, and may vary in size from that of a pea to that of a small cocoanut. Microscopically the tumors consist of branching connective tissue stroma strands covered by high columnar epithelium. These tumors may be pedunculated but usually present a broad sessile base.

The symptoms caused by papillomata are similar to those produced by adenomata. The treatment of the two conditions varies somewhat by virtue of the fact that papillomata tend to undergo malignant changes; in cases of doubt, therefore, as to the benignancy of a papilloma, radical excision should be practiced.

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# DIFFERENTIAL DIAGNOSIS OF PEPTIC ULCER AND CHRONIC APPENDICITIS\*

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THE dependence of the successful medical treatment of uncomplicated peptic ulcer upon proper diagnosis is too well known to need emphasis. The chief cause of the failure of medical treatment of peptic ulcer, when it does fail, is the coexistence of other intraabdominal diseases demanding surgical procedure.

One such affection that is very important to differentiate from peptic ulcer, according to our experience, is chronic appendicitis. We do not intend here to discuss the symptoms and signs of peptic ulcer but shall confine ourselves rather to chronic appendicitis when it simulates peptic ulcer.

Chronic appendicitis is an affection which, as a clinical entity, has been the subject of considerable discussion. Two extreme camps exist with regard to it. One is convinced that the chronically diseased appendix plays a very important rôle in bringing about all kinds of gastrointestinal symptoms, especially those that simulate peptic ulcer. Among this group, we find such authorities as Deaver, Rolleston, George D. Stewart, and others. The other group minimizes chronic appendicitis as a cause of gastrointestinal symptoms, and some go so far as to call its rôle in this connection a myth.

We are frank to admit that the more our experience grows, the more we are convinced that the chronically inflamed appendix not only may but actually does, in a great many instances, cause disturbances in the stomach fully simulating peptic ulcer. We consider that the teaching of George D. Stewart to the effect that 33 per cent of peptic ulcer symptoms are to be sought in a diseased appendix, and that the removal of the cause will do away with the symptoms, should be fully heeded. It is very well known that chronic appendi-

citis may simulate peptic ulcer in every detail, even to the extent of profuse gastric hemorrhage. Several such cases have been encountered by us. Just why chronic appendicitis should cause profuse gastric hemorrhage is impossible of explanation, but it may be that it causes a disturbance in the gastric capillaries so that diapedesis results giving rise to diffuse bleeding (typus Dieulafoy). This capillary diapedesis may be caused by the deleterious effect of toxins on the capillaries. It is interesting to note, as we have mentioned elsewhere,<sup>1</sup> that as a rule gastric hemorrhage resulting from chronic appendicitis, unlike that due to peptic ulcer, is refractory to medical treatment. If the hemorrhage is controlled, it is only for a short period of time. The anemia remains extremely profound and is only slightly influenced by blood transfusions and other measures. If one encounters a case with profuse gastric hemorrhage that is impervious to medical treatment, granting that rupture of the pancreoduodenal blood vessels and an ulcerating carcinoma of the stomach may be ruled out, he may conclude that the gastric hemorrhage is of extragastric origin such as (1) cirrhosis of the liver, (2) thrombosis of the splenic vein with Banti's symptom complex, (3) thrombosis or aneurism of the hepatic artery or (4) chronic appendicitis. The first three of these extragastric affections, although rare, are usually readily recognized. In their absence and in the presence of a profuse gastric hemorrhage that does not surrender to medical treatment, one must think of chronic appendicitis as a cause. We have encountered 5 cases of this type confirmed by operation. The patients were young individuals, the oldest being thirty-three years of age.

It would seem, from experience, that

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there is no justification for the prolongation of the controversy that chronic appendicitis is not the cause of symptoms simulating those of peptic ulcer. However, as stated before, there are still a number of important internists and surgeons who discredit it in this regard. They justify their position by claiming that in many individuals the removal of even a demonstrably diseased appendix fails to do away with the gastric symptoms. Such an argument, however, is not valid because the chronically diseased appendix may have been caused by gastric catarrh which needs care even after appendectomy in order that the symptoms may be permanently relieved. Again, disturbed motor and secretory gastric functions may persist for some time after the appendectomy and need postoperative medical treatment. If this is not administered, the continuous gastric irritation may actually lead to the formation of an ulcer. That this is so has likewise been verified for us by experience. In other cases, extensive pericecal adhesions or adhesions extending to the right hypochondrium exist after the removal of the appendix causing marked gastric symptoms resembling even those of peptic ulcer. In a very few cases it has been demonstrated that the appendicular stump itself may cause irritation in the ileocecal region. Occasionally typhlitis and displacement of the cecum or a thickened cecum may interfere with the function of the colon, particularly of the ascending colon and of the junction of the cecum and ileocecal region, giving rise to gastric symptoms even after the removal of a diseased appendix. This is so well known that it should automatically vitiate any argument that such a diseased appendix was per se not the cause of the original peptic ulcer symptoms.

Another argument often advanced against the chronically diseased appendix as a cause of gastric ulcer symptoms is that frequently such an appendix is removed and, at the time of appendectomy, no ulcer is detected by the surgeon's pains-

taking inspection and palpation of the stomach and duodenum. Notwithstanding, several months, or perhaps a few years later, after a period in which the patient has continued to suffer his peptic ulcer symptoms, another operation becomes necessary, at which a large ulcer is found. On this basis, the argument is advanced that the existence of an ulcer was overlooked during the first operation.

It may be agreed that at the time of the first operation a small ulcer impossible of discovery by the surgeon was present and that had medical treatment been directed against the ulcer after the appendectomy the development of the large ulcer might have been prevented. In reality, we have encountered 3 cases where a small peptic ulcer was present, demonstrable to the surgeon on the operating table, in association with a chronically diseased appendix, but there was no evidence that it had given rise to mechanical disturbance sufficient to warrant gastric surgery. For that reason the surgeon decided to remove only the appendix. These patients were medically treated post-operatively and although a number of years have since elapsed they have experienced no return of their ulcer symptoms. They were all young, two not yet twenty and one in the twenties. This is important because it has been emphasized by many surgeons that if peptic ulcer occurs so early in life, giving rise to persistent symptoms not yielding readily to internal treatment, as a rule gastric surgery eventually becomes necessary.

One reason for the continuance of the controversy regarding the clinical importance of chronic appendicitis is its varied symptomatology. No less a clinician than Sir Humphry Rolleston has tried<sup>4</sup> to create some order by dividing these symptoms into four groups, viz. mechanical, toxic, infectious and reflex. This is not the place to discuss the first three groups, but rather shall we focus our attention upon the fourth group where the symptoms point away from the appendix and are



reflexly referred to the stomach. These may so simulate the manifestations of peptic ulcer that the most careful examination is necessary in order to arrive at a positive diagnosis.

#### HISTORY

The history of an acute attack is of the utmost importance. One encounters many cases, however, where such a history cannot be obtained either because the attack was so mild as to have escaped diagnosis, or, as pointed out by Deaver, occurred so early in life that it was merely diagnosed as some form of intestinal indigestion.

It is curious that quite often when a patient describes his gastric symptoms, particularly when speaking of his pain, he points with his finger not to the duodenal region but to the ileocecal region. *He speaks about pain in his stomach and points to his appendix.* This simple observation has enabled us often to make a correct diagnosis.

Regarding *periodicity*, although in chronic appendicitis simulating peptic ulcer the individual has period aggravation of his symptoms with all the characteristics of peptic ulcer he is not entirely free of symptoms during any period of remission. In this respect he differs from the peptic ulcer patient who, during the period of remission, is symptom free. The gastrointestinal tract of the individual with a chronically inflamed appendix giving rise to peptic ulcer symptoms will respond with abnormal sensations to any form of irritation, particularly to indiscretions in diet. Constipation is especially troublesome to him. It does not cause distress in the colon but one that manifests itself as gastric symptoms.

*Secretory phenomena* such as very marked pyrosis and sour regurgitations may exist. This pyrosis may come on just as in peptic ulcer, viz. two and even three hours after a meal, and may be relieved by bicarbonate of soda. More often, however, it behaves like functional hyper-

secretion without underlying ulcer. It is present the greater part of the day and bicarbonate of soda is not as effective as in peptic ulcer. The pyrosis in the latter is quickly relieved if the patient belches after the bicarbonate of soda. It is also typical that more often than in peptic ulcer the patient will often force himself to vomit excessive secretions in order to be relieved of distress. The pyrosis seldom disturbs the patient's sleep. In the vast majority of peptic ulcer cases, during the period of active symptoms, there are both pain and hypersecretory manifestations. In chronic appendicitis, there may be periods when sensory symptoms predominate and others when hypersecretory symptoms are in the ascendancy, resembling purely functional disturbances of the stomach. This is one reason why these cases are so often considered purely neurotic or hysterical, or as termed by the French, *appendicitis neurasthenique or hysterique*.

*Motor disturbances* present themselves as marked functional disturbances in the epigastric region and sometimes in the form of delayed emptying of the stomach so that the patient may vomit food ingested ten or twelve hours earlier.

When sensory symptoms are in the foreground, the patient complains of actual pain in the epigastric region, one or two hours after a meal. It has been our experience that the pain is never as severe as in the actual peptic ulcer case, except in those rare instances where marked pylorospasm may intermittently occur causing acute attacks resembling perforated peptic ulcer.

#### OBJECTIVE EXAMINATION

*Pressure Tenderness:* In view of the fact that the ileocecal region is often sensitive to pressure even in normal individuals, the diagnostic value of tenderness over the ileocecal region must be carefully weighed. If the appendix is diseased and is the cause of the patient's gastric symptoms, then when pressure is exerted over the ileocecal

region the patient will generally complain of pain in the epigastric region. Where such reflex gastric symptoms exist, the focus of segmental irritation lies in the area supplying the stomach. Mackenzie<sup>2</sup> attributes this local tenderness entirely to the result of spinal nerve irritation of the tenth and twelfth dorsal segments of the cord. A. F. Hurst,<sup>3</sup> on the other hand, believes that the sensation of pain in the epigastric region resulting from pressure over the appendicular region is due to a pyloric dysfunction either in the form of spasm or achalasia. Both agree that the epigastric tenderness in such cases is not due to a direct lesion of the stomach but is of reflex origin. It is our opinion that the explanation of Mackenzie of irritation in the segment of the cord in the region of the stomach is the most responsible factor and that if such irritation persists so that there is a summation of irritating impulses, continuous pain in the organ supplied by the segment will occur. Such cord irritation may cause symptoms after the diseased organ has been removed.

**Hyperesthesia:** This is another objective finding in many of the cases where the appendix is the cause of gastric symptoms. Such hyperesthesia originates in that part of the segment of the cord from which the spinal nerves emerge supplying the skin overlying the organ. An impulse from the affected organ to the segment of the cord travels from this to the brain and from there efferently to the skin. The process is one of double efferent impulse. In the language of Fraser:<sup>4</sup>

Whatever the nature of the impulse, a series of abnormal efferent stimuli originate and are transmitted by way of the sympathetic and the posterior nerve roots to the segment or segments of the spinal cord through which the vagus is innervated. Where it is a question of stress of stimuli or the summation of abnormal stimuli a state of affairs comes to exist in which the respective segments of the cord demonstrate an undue degree of irritability. If, under these circumstances, a stimulation be transmitted to the disturbed spinal segment from the corresponding area of skin distribution that

stimulus is exaggerated by virtue of the spinal irritability. The process is one of a double afferent impulse. The visceral afferent has not

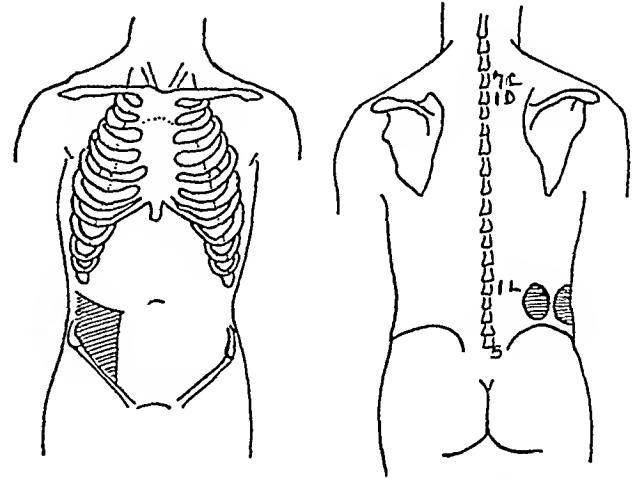


FIG. 1.

FIG. 2.

FIG. 1. Common area of hyperesthesia or hyperalgesia in relation to appendicitis. (Sherren's triangle.) (After Fraser.)

FIG. 2. Areas of hyperalgesia or hyperesthesia in relation to retrocecal appendicitis. (After Fraser.)

entered the sphere of consciousness but is represented as an exaggeration of painful impulse because of the irritated field through which the superficial structure has passed.

If the stimulus to pain originating in the organ is a continuous one, the afferent and efferent messages to the corresponding segment of the cord may give rise to continuous pain without demonstrable objective signs. Individuals complaining of this continuous pain are often stamped as hypochondriacs or hypersensitive, whereas in reality there is pain actually due to a summation of irritating stimuli in the segment of the cord. This persistent hyperalgesia and hyperesthesia may so irritate the center in the cord that even after removal of the diseased organ the irritation continues and symptoms referable to the organ are present. It is this fact that sometimes leads us to state erroneously that the primary cause was not in the diseased organ. Of course, the evaluation of the summation of irritations to the cord as a sign of organic disease is somewhat restricted because such summation of irritation causing pain in the visceral organs aggravated by nerves from these segments may be present without any disease of the

organ, best explaining, according to Linstedt,<sup>5</sup> the different neuralgias simulating organic pain.



FIG. 3. Cecum high with unusually long appendix.

Hyperesthesia and hyperalgesia in association with a diseased appendix are, in a large number of cases, confined to a space over the right side of the abdomen known as Sherren's triangle (Fig. 1). The pin method of determining whether such hyperesthesia or hyperalgesia exists is as follows: The body of the pin is rested upon the lateral edge of the middle finger and the finger is allowed to rest upon the skin so that as the pinpoint travels over the area under investigation it is preceded by the finger. This has a double advantage. The pressure of the pin is maintained constant while the preceding finger prepares the skin for the reception of the pin stimulus. According to Fraser's exact studies, hyperesthesia and hyperalgesia are positive in about 50 per cent of the cases. He has followed up his observations by a study of cases and has made the remarkable observations that it is present only in such cases where the

appendix is over-distended and filled with contents such as inflammatory exudate, parasites or concretions. It is filled with

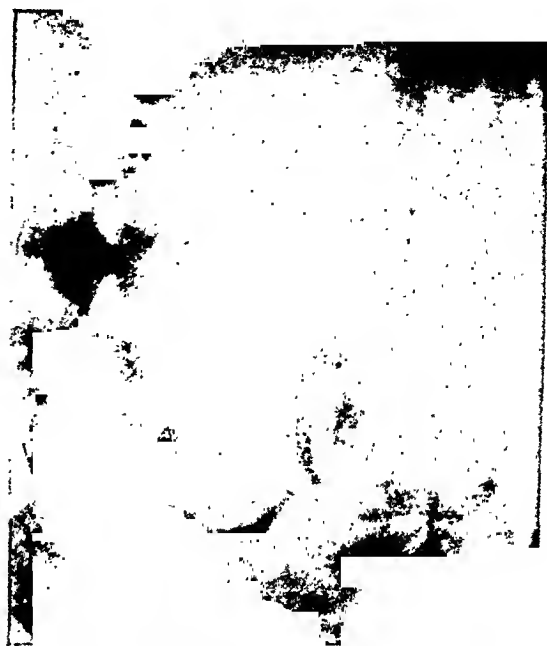


FIG. 4. Chronic adherent appendix thickened in middle part. Patient operated on.

fecaliths or parasites, it can give rise to pain over the appendicular region, hyperesthesia and hyperalgesia, although the pathologist may, upon examining the removed appendix find it absolutely normal.

Livingstone<sup>6</sup> has described a phenomenon in cases of chronic appendicitis that is very typical. Any traction of the skin over the ileocecal region, the skin being pulled upward and outward by the thumb and index finger, gives a definite sensation of pain. Although not present in every case, this phenomenon when it does exist points very strongly to a diseased appendix.

When an appendix is retroceally situated, even in chronic cases, the pain is often referred to the right loin simulating renal pain. It differs from the latter only in the fact that it is more or less continuous and that it is very often accompanied by digestive disturbances. In these cases, an area of hyperesthesia over the right loin is distinctively characteristic (Fig. 2).

**Abdominal Reflexes:** Where hyperesthesia is present, there is also a marked increase of the abdominal reflexes of the affected side, provided, of course, the abdomen is not pendulous and obesity is not marked. This is a very important finding because it indicates that the area of hyperesthesia is not due to underlying peritoneal irritation which causes rigidity of the overlying abdominal wall, but is due to viscus irritation giving a tension of the overlying abdomen. Matthes<sup>7</sup> long ago pointed out that where there is abdominal tension the abdominal reflexes are increased. He utilized this finding to differentiate between abdominal pain brought about by tension of abdominal muscles resulting from pleurisy or pericarditis and that resulting from abdominal rigidity caused by intra-abdominal disease with peritoneal irritation or peritonitis. In the former, the abdominal reflexes are markedly exaggerated whereas in the latter they are diminished or entirely absent.

William Klein,<sup>8</sup> in his study of the importance of abdominal reflexes in intra-abdominal diseases, has differentiated hyperesthesia that is obtained only when the skin is pinched over a diseased organ from the contraction reflex that is a response to scratching of the skin over a particular area. He has found that when the peritoneum is involved, the contraction reflex is absent.

**Percussion Tenderness (Mendel's sign):** According to some authors, this is a frequent finding in chronic appendicitis, but this does not correspond to our experience. We find it frequently present over the duodenal region when duodenal ulcer is present.

**Tenderness on Pressure over the Left Shoulder Clavicular Joint:** When chronic appendicitis gives rise to marked gastric symptoms, we have often found considerable tenderness when pressure is exercised over the anterior part of the left border of the humeroclavicular joint near the acromia process corresponding to a sensitive pressure point on the right side in case of gall bladder disease.

**Pain or Discomfort on Inflation of Colon (Bastedo's sign):** When the colon is inflated with air the patient experiences pain and



FIG. 5. Cecum high with long thick, persistently filled shaped appendix.

discomfort over the appendicular region in the presence of chronic appendicitis. It has also been observed that if the colon is filled with water, pain is experienced over the appendicular region at the time of distention of the colon.

**Pain upon Rectal Examination (Reder's sign):** Upon rectal examination, the patient often states that he experiences pain in the appendicular region. In our experience, this has seldom yielded any information of value. This is the case for us, also, with regard to the Bastedo aids to diagnosis.

**Pain on Pressure over Left Side of Abdomen:** According to Rovsing's finding, pain is experienced in the appendicular region if pressure is exercised on the left side of the abdomen at a point corresponding to McBurney's point on the right side.

#### SECRETORY FINDINGS

Despite the fact that the studies of gastric secretion in chronic appendicitis

fill volumes, the conclusions regarding diagnosis are not consistent. In a large number of cases, although symptoms of

makes possible the visualization of the appendix and reveals its influence, when diseased, upon adjacent organs. Every

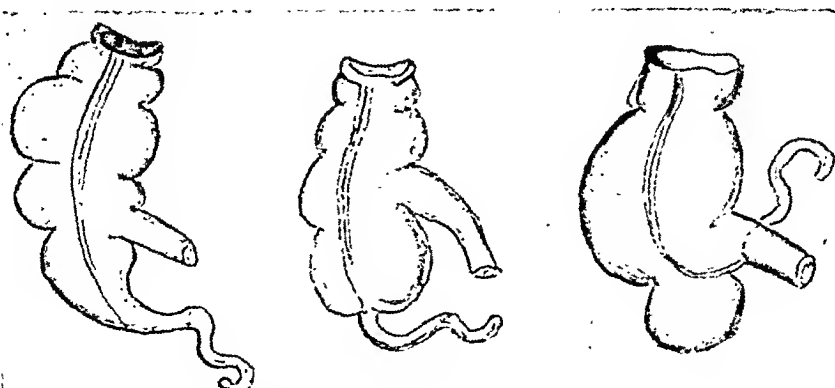


FIG. 6. Various types of direction of appendix from cecum. (After Ludwig Fadder.)

hyperacidity and hypersecretion are present, the acidity figures are normal and actual hypersecretion is not present. We may say, therefore, that much reliance cannot be placed on the gastric secretory findings. In some cases, however, where the acidity is disturbed the manifestation is that of hyperacidity. The acidity may be higher than in gastric ulcer, but it is never as high as in those cases of duodenal ulcer where hyperacidity is present. In peptic ulcer, pyrosis and sour regurgitations generally correspond to actual hyperacidity. By means of the fractional determination of gastric acidity one will find that in chronic appendicitis even where there is hyperacidity, it is not continuous as is the case in duodenal ulcer. At the end of one and one-half or two hours the acid figures are like those of a normal individual or only slightly elevated. Fenwick<sup>9</sup> has tried to differentiate the pathological lesion of chronic appendicitis on the basis of gastric secretions. If the mucous membrane of the appendix is the seat of chronic ulceration there is usually hyperacidity. If the chronic appendicitis is complicated by marked pericecal or appendicular adhesions subacidity is present.

#### ROENTGEN FINDINGS

The diagnostic aid of greatest importance is the roentgen examination, which

effort to visualize the appendix is worth while. We have often been able to demonstrate that at one examination an appendix may fill and at another fail to do so. As a rule, no special efforts are necessary to fill the appendix. It is generally visualized after six, eight or twenty-four hours. Czepa<sup>10</sup> advocates a method that greatly aids in filling an appendix that would remain unfilled otherwise. The object of his method is to liquefy the barium contents of the ileum so that the barium will enter the appendix. For this purpose, he gives epsom salt after the barium meal. Three, six or eight hours later he examines the ileocecal region fluoroscopically and roentgenographically. If the appendix does not fill under fluoroscopic control, he exerts pressure over the ileocecal region and so succeeds in filling it. It must be emphasized, however, that failure of the appendix to fill or the fact that it has filled and remains filled a longer time than normal does not justify a conclusion that the appendix is diseased.

*Size of the Appendix:* The size of the appendix in most cases depends upon the status of the individual. We must not base our diagnosis entirely on the length of the appendix but, as seen in the accompanying illustrations (Fig. 3), if the length is strikingly abnormal and out of proportion to the rest of the abdominal viscera we

may assume that the size of the appendix is due to hypertrophy resulting from disease. An exceptionally small appendix

tations like the colon proving that it empties its contents like the colon. The so-called beaded appendix that, at one



FIG. 7. Appendix filled to left of median line.

must also be considered pathological. The small size is generally due to the fact that the greater part of the appendix is obliterated by chronic inflammation. In these cases, the surgeon will find an abnormally long appendix despite the fact that the roentgen examination showed only a very small organ.

*Shape of the Appendix:* One expects to find the base of the appendix a good deal wider than the apex but not infrequently the reverse is true: the middle portion is wider than the base (Fig. 4). Such a finding is usually evidence of appendicular inflammation. Occasionally during the course of the examination, the entire appendix is seen to lie in a circle or in an s shape or as some other figure. If this distortion persists throughout the examination, the appendix may reasonably be assumed to be pathological (Fig. 5).

*Contractions of the appendix* are still a disputed question. The studies of Max Cohn,<sup>11</sup> a pioneer in roentgenography of the appendix, have convinced him that visualized contractions are merely an indication that the appendix has segmen-

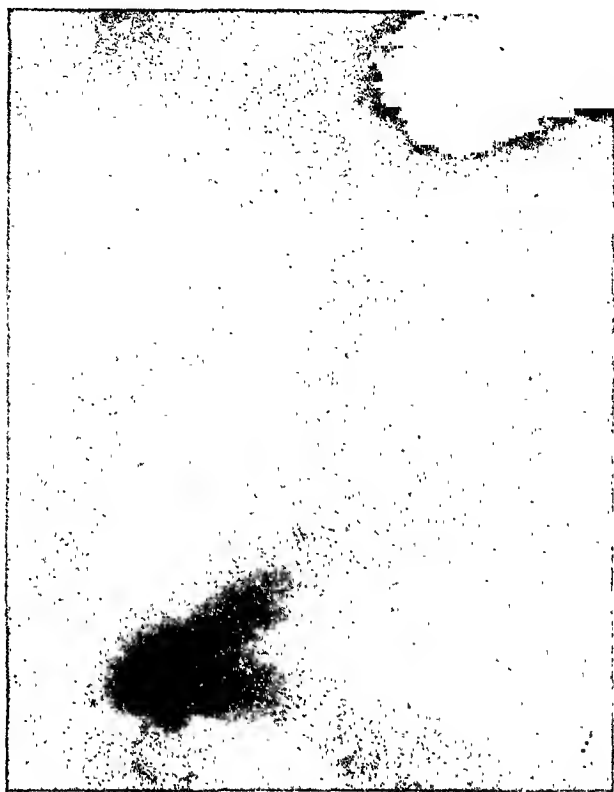


FIG. 8. Appendix short and beaded, obliterated and bound down by adhesions.

time, was considered pathological is according to Cohn only an indication of the normal physiology of the appendix.

*Motility of the Appendix:* This, as indicated by its emptying, is accomplished by the segment of the appendix plus that of the cecum. If an appendix is persistently filled for many days and maintains a continuous shape, it is generally diseased.

*Mobility of the Appendix:* This must be judged in relation to the adjacent organs, particularly the cecum. Where the cecum is normally movable we expect the appendix to be equally mobile. However, if appendicular mobility is restricted but the cecum is freely movable it is reasonable to conclude that the lack of mobility of the appendix is due to appendicular adhesions. In the hypersthenic individual, the cecum is usually high and has a short mesentery, with mobility limited and not demonstrable in even a normal state.

**Position:** It is well known that normally the position of the appendix varies a great deal (Fig. 6). It may be situated very low

a rule, the close adherence of the appendix and the cecum usually causes adhesions between the diseased appendix and the

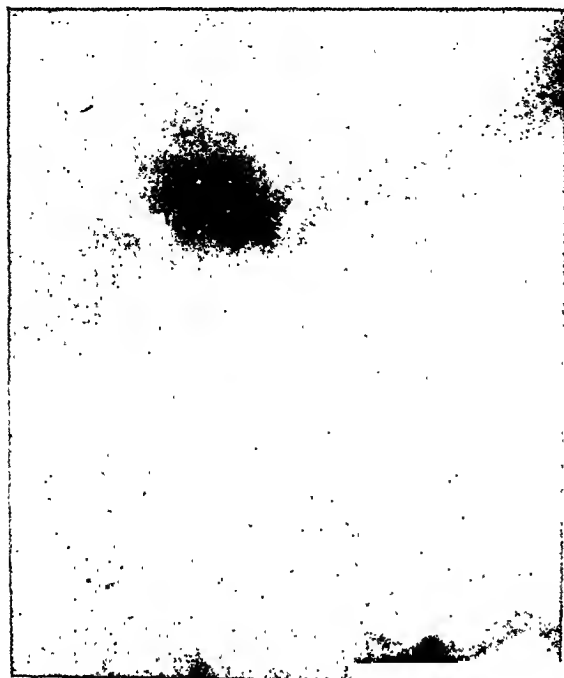


FIG. 9. Retrocecal appendix, forming beaded type of appendix.

in the pelvis, behind the cecum or pointing to the left side of the abdomen. Whether the position of the appendix has pathological significance can only be judged if its relation to the ileum and cecum is considered. If it is situated very low in an asthenic individual in whom the rest of the abdominal viscera are low it is but part of a general status. But if it is situated low and pulls down the ileum, while the cecum and the rest of the colon, particularly the hepatic flexure, are in a normal position, it is quite likely that the position assumed by the appendix and ileum is abnormal, due to adhesions. This is even more so if the appendix is low and the ileac coils remain high, especially if the latter lie in the median or to the left of the median line (Fig. 7). If, in addition, the ileac coils are dilated and contain gas, the diagnosis of ileocecal adhesions, resulting in most cases from chronic appendicitis, can be made with certainty (Fig. 8). As



FIG. 10. Appendix thickened in middle due to chronic appendicitis. Retention in ileum, with spastic cecum simulating Stierlin-Lawrason Brown phenomenon.

cecum so that the abnormal position is present in both conditions, viz. ileac adhesions and cecal adhesions. So we would find that with the appendix pathologically placed retrocecaly, the cecum is usually very high (Fig. 9). If it is pathologically low in the pelvis or is pulled to the left side of the abdomen, the cecum is correspondingly displaced. But we must emphasize that the position of the cecum should be considered abnormal only if its position does not correspond to the status of the individual. In cecum mobile both the appendix and cecum may be found in an abnormal position, either very low or to the left of the median line, without any underlying pathology.

**Cecal Spasm and Ileocecal Stasis:** Marked cecal spasm and particularly ileocecal stasis are indications of appendicular disease. The stasis in the ileum and spasticity of the cecum as a result of chronic appendicitis may be so marked as to simulate the Stierlin or Lawrason-Brown complex of ileocecal tuberculosis (Fig. 10).



Again, marked dilation of the cecum may be present.

Of less diagnostic importance but worthy of consideration, nevertheless, is the putty-like appearance of the cecum that occasionally persists days after the colon is empty (Fig. 11). This finding is significant in that it shows a coaffection of the cecum probably due to catarrh of the mucous membrane of the cecum (typhlitis or perityphlitis secondary to chronic appendicitis).

*Tenderness over Appendix, Fluoroscopically Observed:* This finding is of value only if one is certain that the tenderness is definitely localized over the entire appendix, and only when the area of tenderness varies with the position of the organ. Sometimes dilated ileac coils holding the contrast meal much beyond the normal time may be due to spasm of the ileocecal sphincter, as pointed out by Case.<sup>12</sup>

*Ileocecal Valve Incompetency:* This was at one time actually accepted as pathognomonic of disease in the ileocecal region. In view of the fact that it is encountered in many ulcer individuals, its pathological significance can be utilized only in conjunction with other signs of disease. It is important to remember that where there is marked ileocecal valve incompetency (Case's "third degree ileocecal valve incompetency") a diagnosis of a disturbance in the ileocecal valve is justifiable. This is due, in most cases, to a diseased appendix with ileocecal adhesions.

#### INDIRECT ROENTGEN SIGNS

*Partial or Localized Spasm of the Stomach:* One of the indirect signs tending to explain the gastric symptoms that result from chronic appendicitis is partial or localized spasm of the stomach. Localized spasm, evidenced by indentation on the greater curvature in the pars media, is often seen in the films but is best demonstrated when, under the fluoroscope, pressure is exercised over the appendicular region. It has been our observation that this spastic indentation is particularly marked during the time

pressure is exercised over the appendicular region but at most persists only several minutes. In this respect it differs in its



FIG. 11. Chronic appendix, thickened in proximal part, delay in emptying and gas in ileum and cecum. Putty-like appearance of cecum with adhesions.

diagnostic significance from spastic indentation due to intrinsic disease of the stomach proper, viz. ulcer on the lesser curvature.

One occasionally encounters partial gastroparesis confined to the pars pylorica. This may be so marked and so persistent as to simulate the pivot-shaped pylorus due to cancer. Spasm of the stomach in conjunction with chronic appendicitis is most often encountered in the vagotonic individual. Spasm of the sphincter pylori to the extent of giving rise to marked delay in emptying of the stomach is not common in chronic appendicitis. It is occasionally observed, however, at the time chronic appendicitis gives rise to active peptic ulcer symptoms. Then, despite the normal



position of the stomach and the normal outline of the stomach and duodenum, we encounter gastric residues often beyond eight hours, undoubtedly due either, as Hurst says, to achylasia, or to what we believe to be the case, namely actual spasm of the sphincter pylori. This spasm is evidenced by the fact that the pylorus is unusually dilated and large so that whatever contrast food leaves the stomach does so in the form of a very narrow stream. Fluoroscopically, this spasm differs from the stenosed pyloric obstruction in that the excessive peristaltic waves characteristic of pyloric stenosis are absent.

*Spasm in the Small Intestines:* Chronic appendicitis with marked gastric symptoms may also cause spasm in the small intestines, particularly in the entire ileum, often also in the sigmoid.

*Dilated First Portion of Duodenum:* A not infrequent indirect x-ray finding in chronic appendicitis is a markedly dilated first portion of the duodenum. This has long been recognized clinically. The experi-

mental and clinical observations of Draper and Johnson<sup>13</sup> explain why adhesions as well as appendicular disease do cause such dilation. They found when reproducing ileocecal lesions in the dog that there is a marked dilatation of the duodenum.

#### SUMMARY

An attempt has been made to emphasize the important rôle played by chronic appendicitis in the causation of peptic ulcer symptoms. Often the removal of a chronically diseased appendix removes the cause of peptic irritation and such removal may actually prevent the formation of such an ulcer. The differential diagnosis of chronic appendicitis and peptic ulcer is of the utmost importance because of the possibility of avoiding prolonged medical treatment of the symptoms of peptic ulcer which are due to a chronically diseased appendix. There are sufficient objective criteria to make this differential diagnosis possible, if heeded.

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# THE MANIPULATIVE TREATMENT OF CHRONIC ARTHRITIS OF THE SPINE\*

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**S**PONDYLITIS, a disease entity characterized by pain and stiffness of the vertebral column with or without deformity, has of recent years been the subject of a great deal of comment by orthopedists and medical men in general. Its prevalence, chronicity and varying symptomatology, together with the social and economic importance of its alarming sequelae, have been evidenced by the interest expressed in medical literature throughout the past half-century. Efforts to combat the inroads of this distressing condition have led to the establishing of numerous etiological factors, various types of pathology and manifold classifications based on clinical or morbid anatomical observations. But the treatment has been conservative and perfunctory. The disease has been allowed to proceed to the late stage of deformity, which is not only incapacitating to the patient, but often decidedly painful and difficult to endure.

In view of the fact that so many of these patients have been considered beyond the possibility of relief, and because there has been very little so-called radical treatment instituted, we believe that a general summary of the condition, together with the reporting of several cases which have been treated by manipulation, will tend not only to stimulate further interest in the disease, but will definitely show that it is possible to obtain a correction of the deformity in certain selected cases.

## HISTORY

Skeletons recently unearthed in archeological expeditions have borne mute evidence that spondylitis was a disease factor existing prior to the advent of *homo sapiens*. The condition was prevalent among the Romans and Greeks and its

unmistakable signs have been observed in Egyptian mummies.

Despite the long-standing history and frequent incidence of the disease, and although there had been much in the literature concerning spinal deformities and general osteoarthritis, it was not until 1844 that the condition of arthritis of the spine per se was described by C. G. A. Aldenhoven.<sup>1</sup> Twenty years later, Blezinger and Von Thaden<sup>2</sup> recorded their observation on "Chronic Ankylosing Spondylitis," and, in 1866, Brodhurst<sup>3</sup> in Reynolds's "System of Medicine" described a case of ankylosis of the spine due to gonorrhea. Virchow<sup>4</sup> in 1867 differentiated pathologically between what he called "arthritis deformans" of the spine, with bone formation between the vertebrae and atrophy of the discs, and "osteoarthritis" due to ossification of the spinal ligaments. Ten years later, Fagge<sup>5</sup> gave the first complete post-mortem account of a case in which there was extensive ossification of the spine and hip joints. In 1884, Strümpell<sup>6</sup> reported a case of ankylosis of the spine together with arthritis of the hips and shoulders.

The disease was, however, relegated to a rôle of relative unimportance until 1893, when von Beehterew<sup>7</sup> published his classical description of the clinical syndrome now bearing his name. He described a specific type of spondylitis with the following characteristics: (a) a disease occurring primarily in the spine; (b) having an hereditary factor; (c) history of trauma; (d) sudden onset; (e) pain, diminished sensibility, paresthesia, often twitching in the areas supplied by the dorsal or cervical nerves; (f) parietic condition of muscles of the back, and often the trunk and extremities; (g) hips and shoulders involved to

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minor degree, if at all; (h) limited kyphosis and ankylosis, usually localized in the upper spine; (i) neurological autopsy findings consisting of a degeneration of the posterior roots and the posterior columns in the cervicodorsal region with thickening of the pia and atrophic changes in the dorsal ganglia; (j) rigidity and kyphosis due to gradual degeneration of the nerve roots and parietic state of spinal muscles secondary to chronic lesion of the meninges; (k) kyphosis leading to atrophy of the discs which later gives rise to ankylosis; (l) no ligamentous ossification.

Pierre Marie,<sup>8</sup> in 1898, enlarging on Strümpell's earlier observation, described in detail another variety of spondylitis which he appropriately designated as *spondylose rhizomélisque*, a spondylitis also involving the roots of the extremities. It is manifested by: (a) an arthritis beginning in the hips or lumbar spine and ascending to involve the shoulders; (b) not accompanied by paresthesia or hypesthesia in the trunk or extremities; (c) pain is limited to the spine and hip and shoulder joints; (d) no involvement of the smaller joints; (e) usually infectious in origin. Marie referred to von Bechterew's disease as "heredo-traumatic kyphosis."

Autopsy reports by Leri<sup>9</sup> and Rhein<sup>10</sup> demonstrated the following pathology in *spondylose rhizomélisque*: (a) rigidity of the spine; (b) partial ankylosis of the hips and shoulders; (c) ossification of the periarticular ligaments with hypertrophy of the articular processes and atrophy of the cartilages; (d) very little, if any, degeneration of the posterior spinal roots and no apparent meningeal changes.

Very shortly after these two types of spondylitis were introduced to the literature, the question arose on all sides as to the importance of their differentiation. Gordon,<sup>11</sup> in 1904, broached the question whether they were not variations of the same disease, and suggested that they might be merely forms of a localized arthritis deformans. He reported several intermediary cases, which were not typical

of either of the two varieties and bore certain characteristics of each. Oppenheim,<sup>12</sup> Schlesinger<sup>13</sup> and Zesas<sup>14</sup> were of the same general opinion.

#### PATHOLOGY AND ETIOLOGY

As in every other type of disease, the pathological changes in spondylitis vary in degree in proportion to the severity of the etiological factor, the time elapsed before corrective measures are begun and the efficiency of the treatment instituted. Barring the possibility of a severe infectious arthritis as part of a generalized arthritis deformans, the progress of this disease and the chance for its successful arrest will depend upon the time it has existed before being seen and treated by the physician. When recognized early, eradication of the cause and supportive treatment will tend to prevent any further advance in the disease. However, since most of these cases are permitted to progress to the stage of rigidity and deformity, it is with this condition in mind that we describe the characteristics of the advanced pathology.

The question of spondylitis, as of arthritis in general, has always been an incoordinated jumble of observations, with confusing terminology and an inconsistency characteristic of the disease itself. All of this is based on a limited understanding of the underlying pathological process. Numerous attempts have been made to create some sort of order out of the chaos, and while none has been entirely satisfactory, they have furnished a sound basis for further investigation.

An early division was that into atrophic and hypertrophic arthritis. This idea was elaborated and placed on a sound pathological basis by Nichols and Richardson<sup>15</sup> in their classification of 1909. Arthritis of the spine, however, resisted stubbornly any acceptable morbid anatomical grouping until 1925 when Knaggs<sup>16</sup> suggested the following classification:

#### 1. Spondylitis Ossificans Ligamentosa.

(a) An atrophic arthritis beginning in

the vertebral ligaments, which later ossify and cause ankylosis; (b) begins in lumbar spine and progresses upward; (c) formation of granulation tissue destroying the joint surfaces; (d) lipping of the articular surfaces; (e) thinning of the discs; (f) infectious in origin; (g) the Marie-Strümpell type; (h) x-ray changes are late, and consist of ligamentous ossification, parrot-beaking of articular surfaces, roughening and finally ankylosis; (i) usually in young adult life.

## II. Spondylitis Muscularis.

(a) An hereditary factor; (b) usually a history of trauma; (c) weakness of the spinal muscles causing kyphosis, which produces atrophy of the discs and finally ankylosis; (d) usually not infectious; (e) the von Bechterew type; (f) includes also spondylitis senilis due to atrophy of the spinal muscles; (g) x-ray changes same as Type I except for ligamentous ossification, which is absent; (h) may occur at any age.

## III. Spondylitis Osteoarthritis.

(a) The hypertrophic or degenerative type; (b) degeneration of cartilage and overgrowth of bony tissue; (c) some degree of ankylosis but true bony union is rare, although eburnation in the spine is unusual, due to the small amount of motion between the vertebrae; (d) often present, and visible to the x-ray as hypertrophy of the articulating surfaces and exostoses before onset of symptoms; (e) usually in middle-aged and elderly persons.

A large proportion of the cases of spondylitis seen by the physician are integral parts of a multiple arthritis, and the spinal pathology will then be similar to that found in the other joints, but it can usually be placed in one of these groups. The term "spondylitis deformans" may be applied to any one of these groups in which cases have advanced to the stage of deformity. It presents no specific pathological picture. Under one of these headings

can be placed each of the factors thought to be involved in the etiology of spondylitis. Thus:

### I. Spondylitis Ligamentosa Ossificans Exciting Causes

#### 1. Infection

(a) non-specific; (b) gonococcal; (c) typhoid; (d) scarlatinal; (e) meningitic.

#### 2. Allergic

### Predisposing Causes

#### 1. Trauma

#### 2. Exposure

#### 3. Fatigue

## II. Spondylitis Muscularis

### Exciting Causes

#### 1. Metabolic

2. Trauma: injury or from weight bearing (the *duplicature champêtre* of French writers) and including gout and obesity.<sup>17</sup>

3. Trophic: pachymeningitis, tabes, syringomyelia, spinal muscular atrophy.

### Predisposing Causes

#### 1. Heredity

#### 2. Old age

#### 3. Exposure: myositis.

## III. Spondylitis Osteoarthritis

### Exciting Causes

1. Metabolic,<sup>18</sup> associated with anemia, achlorhydria, hypertension or hypotension, arteriosclerotic changes, intestinal stasis, nephritis.

2. Infection: a minor rôle in this type.

### Predisposing Causes

#### 1. Trauma: including gout and obesity

#### 2. Old age

#### 3. Exposure

It must be realized that there is no hard and fast rule as to etiology of the various types just as there is no absolute method of classification. Thus, cases of Type II may be caused by infection, and those of Type I may be due to metabolic disturbances. In like manner, patients having a clinical picture resembling spondylitis ossificans ligamentosa may show some of the characteristics of spondylitis muscularis. Hence the controversy as to

whether they are not merely different forms of the same disease. In this outline we are attempting to summarize the obser-



FIG. 1.

FIG. 2.

FIGS. 1 and 2. Case of meningococcic meningitis with kyphoscoliosis following treatment by serum given intraspinally. Fig. 1 was taken five weeks after acute symptoms had subsided. Fig. 2 shows condition of spine three months later.

vations of various writers and to present an arbitrary basis from the data obtained in the majority of their cases.

In addition to these causes, there are diseases of the vertebrae themselves accompanied by rigidity and kyphosis, but not coming under the head of arthritis. These include (a) tuberculosis; (b) rickets; (c) Kummel's disease, traumatic rarifying osteitis; (d) malignancy; (e) osteochondritis; (f) osteitis deformans.

Syphilis, it should be noted, allows in most cases increased motion of the vertebrae rather than rigidity. The post-meningitic type is placed in Class 1, because it is apparently an infectious rather than a traumatic affair. Billington<sup>19</sup> reported a series of 35 cases of spondylitis following lumbar puncture in the treatment of meningococcic meningitis. In 12 of these, there were arthritic changes visible by

the x-ray. He expressed the opinion that the organisms were accidentally implanted in the spinal joints by the passage of the lumbar puncture needle anteriorly between the bodies of the vertebrae. We recently saw such a case at the Jewish Hospital on the Medical Service of Dr. Ludwig Loeb. This patient, a boy of fifteen, was treated for meningococcic meningitis by numerous lumbar punctures with instillation of specific serum. After four weeks, when he was entirely rational and the temperature was practically normal, he complained of pain and tenderness in the lower back, shooting down both thighs. Two weeks later, when he was ready to be up in a chair, the pain had disappeared but it was noticed that a moderate lumbar kyphosis and marked left dorsal right lumbar scoliosis had developed. Figure 1 shows the condition of the back five weeks after subsidence of the acute symptoms and nine weeks after the onset of the illness. X-ray of the spine was negative for arthritic changes. There was limitation of anteroposterior and lateral motion and considerable muscle spasm. The patient was treated by baking, fracture boards, hyperextension roll and a back brace. Figure 2 represents the condition three months later. There is practically no deformity and motion of the spine is normal.

#### TREATMENT

In the early stages of the disease, deformity may be prevented or arrested by the ordinary measures of (1) baking, (2) massage, (3) extension exercises and the use of (4) a spinal brace, (5) corset, or (6) plaster jacket. Bed treatment on (7) a frame or (8) fracture boards with (9) hyperextension roll is undoubtedly of value in some cases. (10) Eradication of any focus of infection is, of course, a primary consideration. (11) Electrotherapy with diathermy, galvanic or sinusoidal current has been used to some advantage.

After the onset of the stage of deformity, however, relief has not been so readily

obtained. Jones<sup>24</sup> and many others advise the use of (12) the Paquelin cautery to the deformity, without any record of outstanding results. Some men place the patient upon a frame and with the aid of gravity and (13) weight bags, occasionally obtain some correction of the deformity. All of these measures are extensively used but the results have been somewhat discouraging. Usually the disease progresses so that the kyphosis increases or ankylosis occurs in a position of moderate though disabling deformity.

Special forms of treatment, not so popularly known, have been presented in the literature. (14) Foreign protein therapy has resulted in some improvement and is recommended by Stockman.<sup>20</sup> The use of (15) x-ray therapy has been strongly advised by O'Bannon,<sup>21</sup> who states that pain is markedly relieved even though deformity persists. Eastwood<sup>22</sup> reported a case of spondylitis rhizomélisque associated with achylia gastrica. After treatment with (16) dilute hydrochloric acid, there was increased mobility of the spine and a lessening of the pain. The use of (17) Small's sca antigen has met with little success in this particular type of deforming arthritis.

Various operative measures have been attempted in order to relieve the disability which accompanies the spinal and hip deformity. Peugniez<sup>23</sup> reported a case of ankylosis of the spine and hips on which (18) subtrochanteric osteotomies were performed with the function of false joints. He claimed that the operation produced a comparatively useful patient who was able to walk about and sit in a chair, this being previously impossible.

Most men have been strongly opposed to any form of radical treatment, either surgical or manipulative. Jones,<sup>24</sup> Goldthwait,<sup>25</sup> Deschmann<sup>26</sup> and Frazier<sup>27</sup> have all warned against forceful manipulation of the spine or hips and have decried resections of the hip or any form of plastic work. Nevertheless, we have been of the opinion, and this has been supported by

results, that in certain types of cases (19) manipulative measures are of great value in correcting the deformity and reestablishing the morale in individuals who have received no encouragement and have given themselves up to lives of physical uselessness and mental depression.

The manipulation of cases of spine and hip joint disease is, of course, a measure which was used extensively in the early nineteenth century, only to decrease gradually in popularity until it was given up entirely. In most cases, the results were disastrous. Brodhurst<sup>28</sup> in 1857 described the methods used as early as 1839 in Paris by Louvrier, who had a machine for rupturing ankyloses, with fatal results. Berard in Paris and Palasciano in Naples both used forceful manipulations. Brodhurst himself advised the division of the tensor fascia femoris by puncture wounds, and then, one week later, manipulation of the ankylosis of the hip. Strümpell<sup>29</sup> in 1897 reported the successful manipulation of a hip joint and spine under anesthesia. Since that time, we have been unable to find any record of cases treated by this method, and it has been the almost unanimous opinion that manipulation is not only without effect but is attended by great harm to the patient.

We believe, however, that the reason for failure of manipulative measures in the past has been their indiscriminate use. We accept absolutely the principle that it is useless and dangerous to attempt to rupture bony ankylosis, but we are confident that the cases to be reported will demonstrate the value of manipulation, even though the deformities be persistent and progressive, so long as there is no evidence of osseous union by roentgenological examination. Other causes of kyphosis which contraindicate manipulation are Pott's disease, syphilis, rickets, Kümmel's disease, malignancy, Scheuermann's disease (osteochondritis) and osteitis deformans. In the cases of Type II it may be a method of preventing ankylosis; but in all cases, even though bony union follows,

ankylosis will be in a position which is less incapacitating to the patient and will consequently avoid the complete disability so

# CASE REPORTS

CASE I. R. H., male, aged twenty-four, was admitted to the Warren Hospital, Phillipsburg,

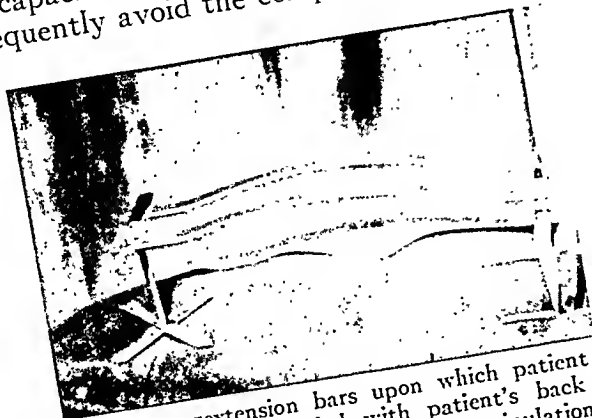


FIG. 3. Hyperextension bars upon which patient is placed and cast applied with patient's back in corrected position, following spinal manipulation.

commonly seen in advanced stages of the disease.

## OPERATIVE TECHNIC

The patient is anesthetized, preferably with ether, and when entirely relaxed, he is turned on his abdomen. With one assistant holding each lower extremity up from the table, the operator manipulates the area of the spine showing the greatest deformity, usually the lower dorsal and lumbar region. During the manipulation there is usually a definite sound of the breaking up of fibrous adhesions. The pressure is continued over the deformity until the spine is slightly over-corrected. A plaster of Paris cast is then applied with the patient resting on hyperextension bars (Fig. 3), the cast extending from the arms pits down to the knees. The cast is allowed to remain on for ten days to two weeks, at the end of which time it is bivalved and baking and massage instituted. As the patient grows stronger, he is allowed to be out of the cast for increasing intervals of time, and, when strong enough to stand, a brace is applied holding the back in the corrected position (Fig. 4).

In some cases it may be necessary to manipulate the hips, provided there is no bony ankylosis. In one of our cases, an arthroplasty of one hip was performed following spinal manipulation.



FIG. 4. Merrill back brace used to maintain correction following manipulation.

N. J. in July, 1929. He was in good health until November, 1927, when he began to complain of backache. There was no hereditary factor. Patient denied venereal disease. There was no history of trauma. Patient complained of pain in the lumbar region while lying in bed. There was no stiffness of the back at this time. Patient felt tired in the morning. Soon the backaches became more frequent but were not severe. In November, 1928 he noticed a stiffness of the right hip followed shortly by a stiffness of the left hip. He was treated medically for rheumatism. There was pain only on forced motion, and patient was never bedridden. The hips became progressively stiffer and patient had to walk with a cane. He noticed a gradual curvature of the back and in May,



1929 he was unable to straighten up. He drove his automobile until July, 1929.

The teeth and tonsils were ruled out as a

thigh and began to limp. There was limitation of hip motion. He was treated for sciatica with medicine, baking, Buck's extension and cast.



FIG. 5.

FIG. 5. Position which Case 1 was forced to assume prior to manipulation. Taken postoperatively in contrast with Fig. 6.

source of infection. X-ray of the spine in July showed no bony deposits to cause ankylosis. In July, 1929, the spine was manipulated under anesthesia. Patient was in a cast for two weeks. He wore a back brace for a period of two months, but after that time refused any support besides a cane. Although motion in the back and hips is still greatly limited, patient is able to stand erect, to lie flat in bed and walk about with greater assurance. There has as yet been no bony ankylosis. Figures 5 and 6, both taken postoperatively, give some idea as to the amount of correction obtained.

CASE II. E. F., male, aged twenty-three, a bellboy, was admitted to the University Hospital on August 12, 1929. He gave a history of rheumatic fever at the age of nine, and four attacks of pneumonia. He denied venereal disease. There was no similar disease in the family. He often complained of evanescent stiffness and pain in the hips, also of pain in the left shoulder starting in 1924. He was in good general health until three years prior to admission, when he fell on his left hip. Four months later he complained of pain in the left



FIG. 6.

FIG. 6. Six months after spinal manipulation.

The result was relief of pain, but he could not move the left hip. Tonsillectomy was performed in 1927.

In November, 1928 patient complained of stiffness of the right hip and this was progressive. He was in the University Hospital on the Medical Service from December, 1928 to March, 1929. Prior to admission, patient noticed a gradual stiffness of the back and, at the time he entered the hospital, he was unable to fully extend the spine. He could not lie flat in bed. He attributed this to the use of crutches during the previous two years.

Upon examination in December, 1928, patient showed a decided limitation of the spinal movements with general kyphosis. The right hip showed a flexion deformity of  $35^\circ$  and could be flexed to  $50^\circ$ . There was only  $5^\circ$  to  $8^\circ$  rotation. The left hip was ankylosed in  $40^\circ$  flexion and  $20^\circ$  abduction deformity. The left shoulder showed only one-fifth normal internal rotation. X-ray showed atrophic changes in both hip joints and bilateral sacroiliac disease. There was a pansinusitis and several infected teeth. Antrum puncture was done, but no pus was found. Several teeth were extracted. Patient was on fracture boards with



Buck's extension to the right leg for two weeks and was given baking and massage. There was no other evidence of focal infection.

both hips is contemplated. Figures 7 and 8 demonstrate the position of the patient before and four months after manipulation.



FIG. 7.

FIG. 8.

FIGS. 7 and 8. Change in position of spine in Case II, brought about by manipulation. Fig. 7 taken just before operation and Fig. 8 four months later.

Patient was discharged from the Medical Service in March, 1929. He had no pain, but was unable to bend his hips or straighten his back. There was no paresthesia in the legs, but occasional muscle spasm was present. The condition gradually progressed to complete disability. Patient had been unable to work for three years, but had previously been able to get about on crutches.

He was readmitted to the Orthopedic Service in August, 1929. X-ray at that time was negative for bony or ligamentous changes in the spine, but the normal curve was gone. The hip joints were the same as previously described. The sacroiliac joints were obliterated.

On August 30, 1929, the spine and right hip were manipulated under anesthesia and patient was in a cast for ten days. On September 13, an arthroplasty of the left hip was performed. Following this procedure, patient received a course of baking and massage.

At present, four months after operation, the spine is straight and patient stands erect. Motion is however markedly limited and stiffness of both hip joints prevents walking without crutches. Patient feels that his condition has been greatly improved. Manipulation of

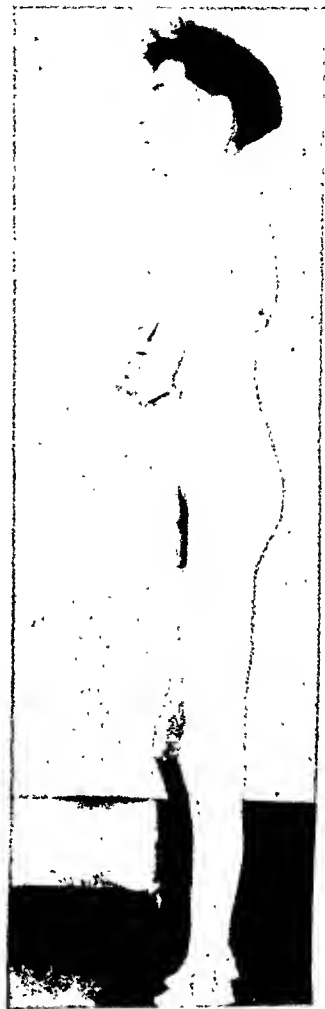


FIG. 9. Case III, two weeks after manipulation. Prior to this operation there was 35° flexion of spine on hips and flattening of normal lumbar curve.

CASE III. F. W., male, aged twenty-six, was admitted to the Graduate Hospital on February 15, 1930, complaining of pain and stiffness of the right leg and stiffness and curvature of the spine. The family history was negative. There was no history of injury, exposure, etc. Two years previously he began to complain of a pain and stiffness of the right knee, followed shortly by a similar condition of the right ankle, toes and hips. Before that time there had been no trouble with the joints, except for evanescent pains in both shoulders. Following the pain in the joints of the right leg, patient noticed a sharp, shooting, intermittent pain

down the right thigh and calf with a dull, constant pain in these parts between the sharper attacks. A few weeks after the onset of joint pain, patient noticed a gradual curvature of the shoulders and spine. There was very little pain or discomfort in the back, but very shortly he was unable to stand erect or lie flat in bed. Patient was unable to work since the onset of illness, although he could be up and about.

Physical examination revealed decreased motion of all the joints of the right leg, together with crepitation of the knee joint. There was moderate kyphosis chiefly in the lower dorsal region. Spinal movements were markedly impaired.

Patient gave no history of rheumatic fever. Tonsillectomy was performed and eighteen teeth were extracted one year after onset of illness. Gastrointestinal x-ray showed a slight intestinal stasis, but there was no evidence of any other focus of infection. X-ray of the spine showed no osseous change.

On February 10, 1930, the spine was manipulated under ether anesthesia and the patient was placed in a cast in the corrected position. After ten days, a back brace was applied, and he is now, one month later, walking about perfectly erect. The back causes him no pain, and although the condition of the right leg remains the same and there is still limitation of spinal movement, patient claims that he feels better than at any time since the onset of his illness. Figure 9 shows the position of the spine two weeks following manipulation.

CASE IV. C. Van B., male, aged thirty, was admitted to St. Luke's Hospital, Pittsfield, Mass., in January, 1930. He gave a history of a fall on the back two years previously, followed by continual backaches with stiffness and deformity of the spine. None of the other joints was involved. The deformity of the spine was progressive and patient was unable to do any work.

All foci of infection had been eliminated and patient had received baking, massage and brace treatment with no relief. There was tenderness over the dorsolumbar spine, and 40° flexion of the spine on the hips. Motion of the spine was markedly limited. The other joints were apparently normal. X-ray of the spine showed no advanced arthritic changes.

On January 20, 1930, the spine was manipulated and patient remained in a hyperextension

east for two weeks. Since that time patient has been wearing a back brace. At this time, two months later, he stands perfectly erect, complains of no pain and is able to do a moderate amount of light work.

#### SUMMARY

Despite our small series of cases, we feel justified in presenting the following deductions:

1. In early cases of spondylitis, deformity may be prevented by ordinary measures of physiotherapy and support.

2. The majority of cases of spondylitis are permitted to advance to the stage of deformity.

3. In the stage of deformity, there is admittedly little hope for permanent cure of the disease.

4. It is therefore an orthopedic problem to correct the existing deformity and prevent its progress.

5. When the disease has advanced to the stage of bony union, corrective measures are injurious to the life of the patient.

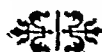
6. If deformity without bony union is present, correction may be obtained by forceful manipulation and maintained by orthopedic appliances.

7. The operation is justifiable in that it not only makes the patient a more useful member of the community but also materially relieves the mental drudgery of his affliction.

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[For remainder of Bibliography see p. 304.]



# SOME OBSERVATIONS IN CALCIUM FIXATION\*

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WITHIN the past few years there has been considerable investigation and advance in the development of therapeutic agencies to correct calcium deficiencies, but even so, the subject of calcium fixation and the mechanism thereof is still a problem.

Calcium privation seems to be due rather to faulty assimilation than to dietary deficiencies. Hence, it would seem that if the patient is to be benefited materially, attention should be directed toward supplying him with this mineral in a form which is more easily assimilable, than that in the food to which he is accustomed.

With this in mind we prepared a mixture of organic calcium and phosphorus, closely related to the mineral composition found in normal bone and tooth structure.

The formula of this was

Combined calcium salts.....	2 grains
Phosphorus (lipoid).....	$\frac{3}{4}$ grain
Magnesium salts.....	$\frac{1}{4}$ grain
Silicic acid.....	$\frac{1}{8}$ grain

This was routinely administered to a series of cases of fracture showing delayed union and non-union. The period of non-union varied from a few months to four and one-half years, as shown in the following case reports.

CASE I. W. B., white, male, aged thirteen, was admitted to the Lutheran Memorial Hospital on Feb. 5, 1927 after having received multiple injuries as a result of being struck by an automobile. He was unconscious and bleeding from ears, nose and mouth because of a skull fracture. His left femur was also fractured, but because of his serious condition it could not be reduced at the time. Four days later, under anesthesia, the fracture was reduced on the Howley table and plaster spica was applied. X-rays demonstrated perfect position of the fragments.

On March 10, 1927 there was considerable over-riding of the fragments (2 in.) so an open operation was performed.

The callus was removed and an ivory peg was inserted into the medullary canal with the ends of fragments approximated. Plaster spica was applied.

On March 30, 1927, x-rays showed three-fourths of the bone ends in contact with considerable callus along the fragments but very little at the ends.

On April 20, 1927 on removal of the cast the x-rays revealed about two-thirds of the ends of fragments in opposition with very little callus at the site of fracture. The ivory peg was broken and there was a marked angulation at the position of the fracture. A very definite false point of motion was present. No union had resulted.

A long plaster spica was applied from the toes to the axilla correcting the angular deformity. This cast was worn till Sept. 13, 1927, when x-rays revealed the non-union (Fig. 1).

At this time another plaster spica was applied and because of his slow non-union we thought it advisable to reinforce his diet with a mixture of inorganic and organic compounds of minerals to hasten his union.

On Jan. 24, 1928 or four and one-third months later the cast was removed and x-rays as well as physical examination revealed a marked sclerosis of the femur, with firm bony union (Fig. 2).

The immobilization was discontinued as his condition was cured.

CASE II. Joe: white, male, aged forty years, sustained a fracture of both bones of his left leg by being run over by an automobile. He was taken to St. Mary's Hospital early in Nov. 1923. On Nov. 17, 1923, a Lane plate was applied and leg was immobilized in a plaster cast. On Dec. 1, 1923 the Lane plate was removed and plaster cast applied. On Jan. 26, 1924 the leg was operated on again with the excision of sequestra and on Feb. 2, 1924 he was discharged.

He was first seen by us on Nov. 4, 1925 at which time the left leg was bowed outward at the junction of the lower and middle thirds. Measured from the top of tibia to the internal

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malleolus, the leg shows more than 2 in. of shortening. There is a definite false point of motion in the tibia 5 in. above the internal

His postoperative convalescence was quite normal, but in a few weeks' time, because of an offensive odor the cast was opened and the



FIG. 1.

FIG. 2.

FIG. 1. CASE 1. Fracture of femur with delayed union seven and one-half months' duration or six months after open reduction.

FIG. 2. CASE 1. Solid union four and one-third months later.

malleolus, while the false point of motion in the fibula is  $\frac{3}{4}$  in. below that in the tibia. There is some enlargement of the veins along the front of tibia for a distance of 6 in. The scars from previous operation seem well healed.

X-rays at this time revealed a non-union with mal-position of the fragments. The upper end of the lower fragment of the tibia is under the lower end of the upper fragment of the fibula.

We advised open operation. He was admitted to my Orthopedic Service at Cook County Hospital, where I operated on the leg in Dec. 1925. Because of the malposition, all structures had to be freed from the ends of all fragments for quite a distance so that proper alignment of the bones could be accomplished. Then a sliding bone graft of the tibia was made.

Owing to the fact that his operative condition was not good the graft could not be securely fastened and the wound was hastily closed. Plaster cast was applied.



FIG. 3.

FIG. 4.

FIG. 3. CASE 11. Fracture of tibia and fibula with non-union of three years' and seven months' duration.

FIG. 4. CASE 11. Solid bone union six months later.

flap of skin sloughed off exposing the free bone graft, which was removed.

He was discharged from the Cook County Hospital and came to my Orthopedic Service at the Home for Destitute Crippled Children on Feb. 19, 1926 for dressings.

From this date to June 6, 1927 the leg was immobilized in either a cast or a brace, in which weight bearing was permitted. During this time many had advised amputation. On June 6, 1927 there was still a definite non-union (Fig. 3).

At this time his diet was reinforced with a mixture of organic and inorganic compounds of minerals with the view of obtaining union, and immobilization was continued. In Jan. 1928 x-rays together with physical examination revealed a firm union of bone (Fig. 4). Since that time he has received no treatment and has been doing heavy manual labor.

CASE III. W. E. S., thirty years of age sustained an injury in a fall from a motor cycle on July 10, 1929.

Two attempts were made to reduce it, the second attempt under gas anesthesia.

On Aug. 3, he was first seen by us. He had a

cast on the arm. X-rays revealed considerable malposition in that the upper end of the lower fragment was displaced to the ulnar and exten-

drilled holes in the ends of the bones. A long plaster cast was applied from the shoulder to the fingers.



FIG. 5A & B. CASE III. Fracture of radius with delayed union of two and one-half months' duration.

sor side. There was no evidence of callus. Because of the malposition and the lack of union, open reduction was advised.

On Aug. 5 at St. Francis Hospital the fractured ends were exposed. There was no evidence of callus. The fragments were approximated and because of the patient's opposition to the insertion of foreign materials the fragments were secured by strong catgut, through



FIG. 6. CASE III. Union in six weeks.

On Sept. 27, 1929 as shown in the x-ray (Fig. 5), there was very little evidence of callus, and there was a definite false point of motion.

At this time on investigation of a reason for his lack of union it was learned that just before his accident he had been a donor for several blood transfusions.

He was then given some of the mineral salts and when he was seen again, on Nov. 13, he had gained several pounds in weight and his marked anemia had disappeared.

At this time union seemed to be quite firm, and x-rays showed (Fig. 6) a definite callus. He was advised to continue to wear a coaptation splint from the wrist to the elbow for fear of another possible injury.

CASE IV. A lady of about fifty-five years of age fell on an ice-covered driveway, injuring her right hip on Jan. 14, 1929.

Physical examination was negative, except for the characteristic findings of a fracture of the neck of the femur with  $1\frac{3}{4}$  in. of shortening.

out on normal rabbits. These animals were from the same litter and they had shared the same food and environment. Their

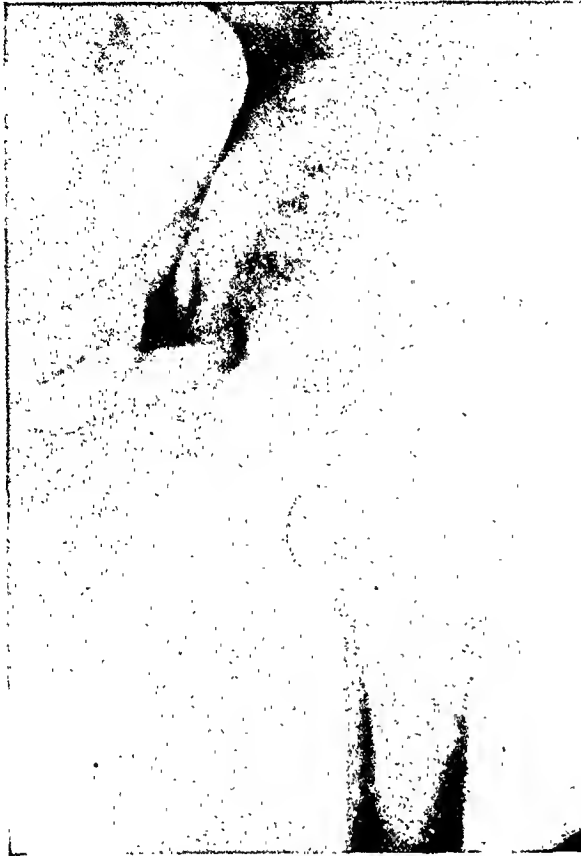


FIG. 7. CASE IV. Fracture of neck of femur treated by Whitman method for two and one-half months showing definite space between fragments.

On Jan. 16 under ether the fracture was reduced, and immobilized after the Whitman Method.

On April 1, the legs were approximately the same length, but x-rays (Fig. 7) at that time did not reveal a firm union, but did show a definite space between the fragments. At this time she was given some additional mineral salts and another short plaster spica was applied.

X-rays taken on May 25 (Fig. 8) reveal a definite solid bony union. The space between the fragments was filled with bony callus.

The cast was removed and she has walked on the limb since, without any walking caliper or other support, and there has been no change in the angle formed by the head, neck and shaft of the femur.

As a further step in testing the efficiency of the substance, experiments were carried

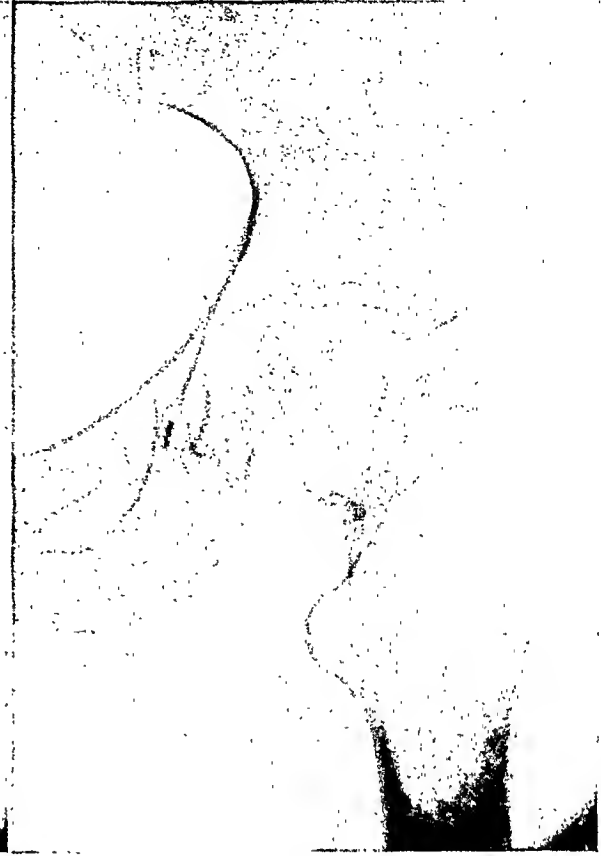


FIG. 8. CASE IV. Solid weight bearing 7 weeks later.

regular diet after they were weaned consisted of an abundance of oats, hay, carrots and cabbage.

Under ether anesthesia the tibia and fibula of these animals were fractured and splinted in malposition. These animals were all fed on this diet, but to one-half of them was administered a daily dosage of this calcium phosphorus mixture, amounting to  $1/50,000$  of the animal's body weight.

X-ray photographs were taken at weekly intervals. In the first group of animals receiving a normal diet minus the mineral mixture, a moderate callus resulted after two weeks, but it required slightly more than three weeks' time to get a weight bearing union.

In the second group of animals receiving the normal diet reinforced with the mineral mixture, x-rays showed a marked solidifi-

cation and a weight bearing union in less than two weeks' time.

To obviate the variation in animals it

was a definite production of callus and a weight bearing union in less than two weeks, while in three weeks there was a

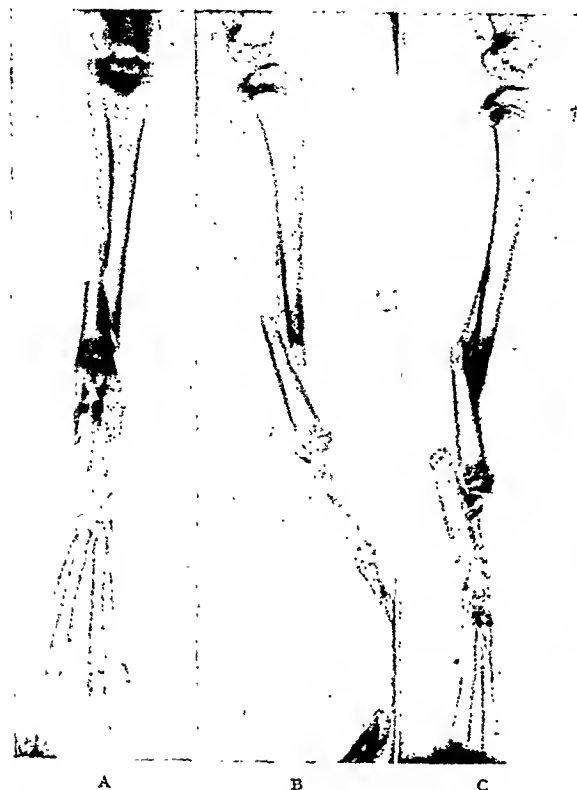


FIG. 9, A, B, C. Views of degree of normal repair in experimental fracture of tibia and fibula of a rabbit on normal diet. A, seventh day, B, fourteenth day, C, twenty-first day.

was next decided to carry out the same experiment on a single animal. Accordingly, the tibia and fibula of the left leg were fractured and successive x-rays were taken at seven-day intervals as shown in Figures A, B, C. Some callus was noted on the fourteenth day and more on the twenty-first day, although the union was not very firm.

At this time (twenty-first day) the right tibia and fibula were also fractured and the diet was reinforced with 20 mg. (1/50,000 of body weight) daily of the calcium-phosphorus mixture. Here the x-rays showed (Figs. D, E, F) that there



FIG. 9, D, E, F. Views of degree of repair of fracture of tibia and fibula in same animal during next three weeks with same normal diet reinforced by mineral mixture. D, seventh day, E, fourteenth day, F, twenty-first day.

very marked production of callus as shown by Figure F.

As the author is a clinician rather than a chemist, these experiments have been conducted from the standpoint of their possible value in actual practice. No unique theories, therefore, have been advanced to account for the *modus operandi* of treatment, save that it is based on a rational therapeutic principle.

It is felt that the results obtained in these investigations are sufficiently encouraging to warrant further research along these lines.



# BLOODLESS MODIFICATION OF PORRO-CESAREAN SECTION\*

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IN-SO-FAR as Porro-cesarean sections are indicated in cases of possible infection of the uterus and more rarely in fibroid tumors, it is absolutely necessary, in order to prevent uninterrupted convalescence, that we conserve all possible blood, and prevent contamination of the peritoneal cavity.

Undoubtedly contamination of the peritoneal cavity by amniotic fluid and blood causes a low-grade peritonitis, which in the presence of infection might easily prove fatal.

In order to make the operation as clean and bloodless as possible, I use the following technic:

The vagina is mopped with 2 per cent mercurochrome solution. The abdomen is prepared in the usual manner, and painted with tincture of iodine. Midline incision is made the size to permit eventration of the uterus. The intestines are walled off, only large laparotomy towels being used, a safeguard against worry or loss. The infundibulopelvic ligaments are now clamped and cut between clamps. The peritoneum and bladder fold are dissected off the lower segment of the uterus; the uterine arteries and veins are next clamped. With the exception of a few anastomotic branches from the cervix, the blood circulation is entirely controlled and cut off.

The uterus is now opened wide, care being taken not to rupture the membranes by starting the dissection of the placenta at its insertion. The whole gestation sac can be lifted out intact, placed on a table away from the sterile field and opened. If necessary the baby can be resuscitated.

The procedure can be manipulated in a few minutes, with practically no danger to the baby.

The uterus is now seized with two large clamps to close the rent, and held in position to be resected. After the uterus has been resected, bleeding points in the cervix are controlled. Two rows of No. 1 chromic catgut are placed in the cervical stump to invert the edges toward the vagina. After the uterine vessels and the infundibulopelvic ligaments have been tied off, a third row of No. 2 chromic catgut approximates the edge of the peritoneum from the right to the left ovarian arteries, making the cervical stump extraperitoneal. The abdomen is then closed in the usual manner.

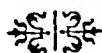
The anesthetic of choice, is nitrous-oxide-ether, without morphine.

I believe that by adhering closely to the above technic, that the mortality of Porro-cesareans will be reduced and also that the convalescence and postoperative complications will be less marked.

In using this technic, we prevent the waste of blood that is associated with the classical method, especially bleeding from the incision in the uterus and from the open vessels at the placental site after extraction of the placenta. As this is of such importance in preventing postoperative shock, I consider it an important and practical addition to a valuable operation.

The difference between this operation and the original one described by Porro, is that the blood supply to the uterus is ligated before making the incision and the gestation sac is delivered intact.

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# COMBINATION ANESTHESIA

WITH SODIUM ISOAMYL ETHYL BARBITURATE AS THE BASAL AGENT\*

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TWO hundred surgical cases, very largely in the service of Dr. Rexwald Brown and his associates Drs. Irving Willis and L. Eder, in the Santa Barbara Cottage Hospital, in which complete or partial hypnosis was produced by intravenous sodium isoamylethyl barbiturate, is a small group; nevertheless, the cases were in the field of general surgery and furnished material for clinical trials of a combination anesthesia in which sodium amytal served as the basal agent.

In this group the ages varied from thirteen years to eighty-one years, and the

cases are arranged as shown in Table 1.

## DETERMINATION OF DOSAGE

In preliminary observations published by the manufacturer, it was recommended that sodium amytal in doses of 20 to 25 mg. per kilogram of body weight be used for prolonged surgical anesthesia. In order to use sodium amytal as the basal agent in anesthesia, this dosage was regarded by us as the maximum. This was computed as grain 1 per 10 lb. of body weight. We estimated that temperature, thyroid dysfunction, age, development, cachexia, dehydration, preoperative medication, type of operation, duration of operative procedure, etc., would alter the amount of sodium amytal necessary to produce satisfactory narcosis, and allowances were made for such factors.

Patients with hypertension and arteriosclerosis were observed to react more quickly to sodium amytal, and required less than patients having normal blood pressure. Obese patients required less per kilogram than did lean or muscular patients weighing approximately the same. An increase in metabolic rate required an increase in the amount of sodium amytal, and this was manifested in adolescents who required more per kilogram of body weight.

A decrease of 3 to 5 grains of sodium amytal was possible by increasing the preoperative morphine from grain  $\frac{1}{6}$  to grain  $\frac{1}{4}$ . Alcoholics and patients who had been receiving barbituric acid derivatives for sleeplessness over long periods, required the maximum dosage. The average dose required for laparotomy was 11 to 13 grains.

The relatively small dose of 10 mg. per kilogram of body weight, or grain 1 per 20 lb. of body weight, was used in combination

TABLE 1

Thyroidectomy.....	7
Breast amputation.....	7
Cholecystotomy.....	4
Cholecystectomy.....	13
Gastroenterostomy.....	3
Gastrostomy.....	2
Perforation of ulcer of pylorus.....	2
Iliostomy.....	1
Appendectomy.....	16
Bowel obstruction.....	3
Resection of sigmoid.....	3
Colostomy.....	4
Hemorrhoidectomy.....	8
Hernioplasty.....	10
Amputation, leg-thigh.....	6
Hysterectomy.....	16
Salpingectomy.....	10
Removal of ovarian cyst.....	4
Suspension of uterus.....	20
Ectopic pregnancy.....	3
Cesarean section.....	1
Fractures, open reductions.....	5
Nephrectomy.....	4
Ureterolithotomy.....	2
Urctero-plasty.....	1
Resection of bladder tumor.....	4
Prostatectomy.....	10
Cystoscopy.....	4
Cystoscopy with pyelogram.....	4
Miscellaneous.....	22
Tuberculous peritonitis	
Brain tumor	
Kondoleon operation	
Inoperable after exploration	
Skin graft	
Tonsillectomy	
Resection of nasal septum	
Total cases.....	200

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with local anesthesia for cystoscopy and nose and throat operations. In these instances, the patients did not lose con-

sciousness. This drug was used in the following observations made at Mayo Clinic. It apparently had a mild sedative

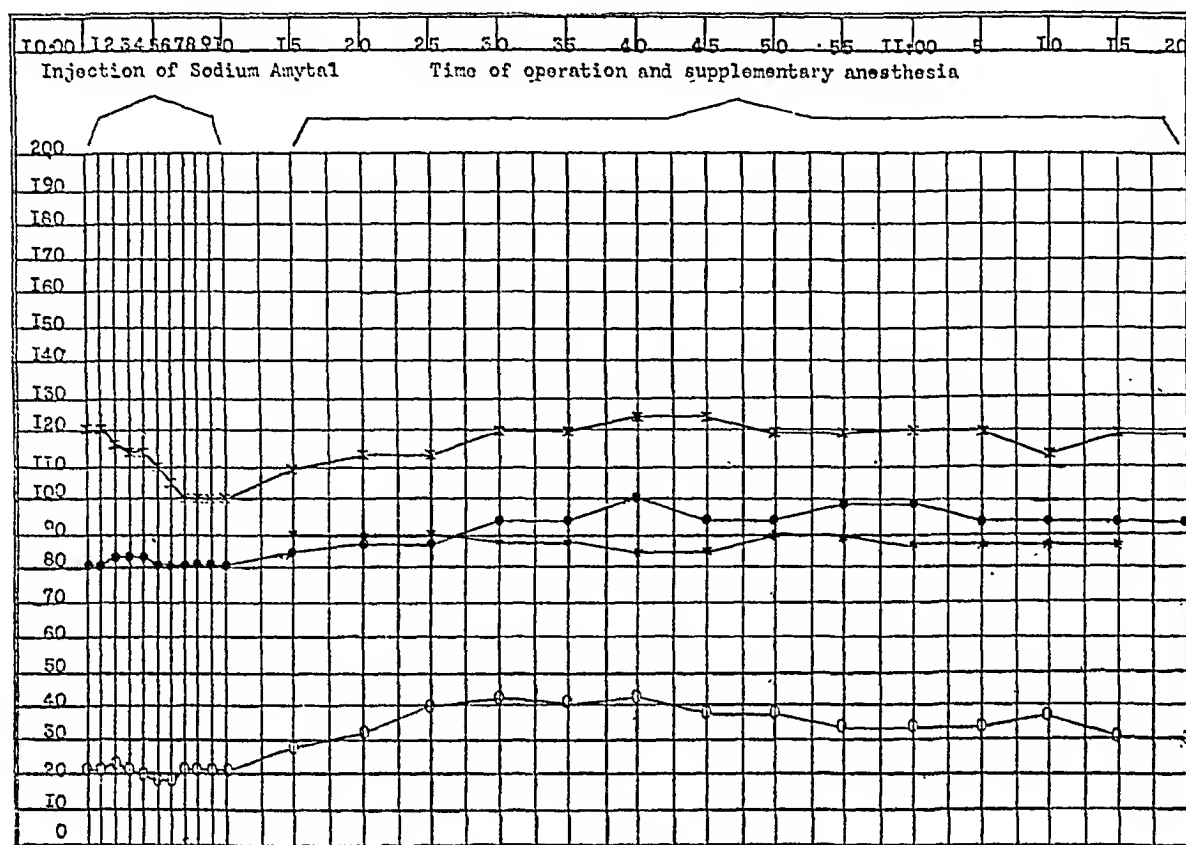


FIG. 1.

sciousness, and they were susceptible to requests, so that pyelograms were obtainable if desired, or the patients were able to cough and raise mucus or blood as the case might be. The patients would often complain bitterly and appear rational, yet none of them had any memory of painful experiences. We observed a score of patients using these figures as maximum dosage; sodium amytal dosage was decreased as the number of surgical cases increased, the quantity administered being determined by the immediate reaction of the patient during the injection, and by the degree of hypnosis desired.

#### PREOPERATIVE PREPARATION

The skin, gastrointestinal tract, genitourinary tract, etc., were prepared as usual, depending upon the operation to be performed. Each patient was weighed. The night prior, and two hours before operation, the patient received chlorbu-

action. Adult patients received morphine sulphate grain  $\frac{1}{6}$  or grain  $\frac{1}{4}$  with atropine sulphate grain  $\frac{1}{150}$ , subcutaneously, one-half hour before operation. Adolescent patients received no narcotic, but were given atropine sulphate in doses depending upon their ages. Sodium amytal was then administered to the patient while in bed in his or her room.

#### ADMINISTRATION

Sodium amytal as dispensed, when mixed, formed a 10 per cent solution. No solution was allowed to stand for longer than fifteen minutes before used, and a solution was discarded if not clear and cloudless. A 10 per cent solution was injected intravenously not more rapidly than 1.0 c.c. per minute. In cases in which profound hypnosis was desired, the rate of injection was decreased to 0.5 c.c. per minute as soon as the patient became unconscious. A record of systolic blood

pressure, pulse and respirations was made during each minute of injection and at five-minute intervals throughout operating drug. The majority of patients complained of diplopia and a sense of fatigue. A few patients suffered a mild

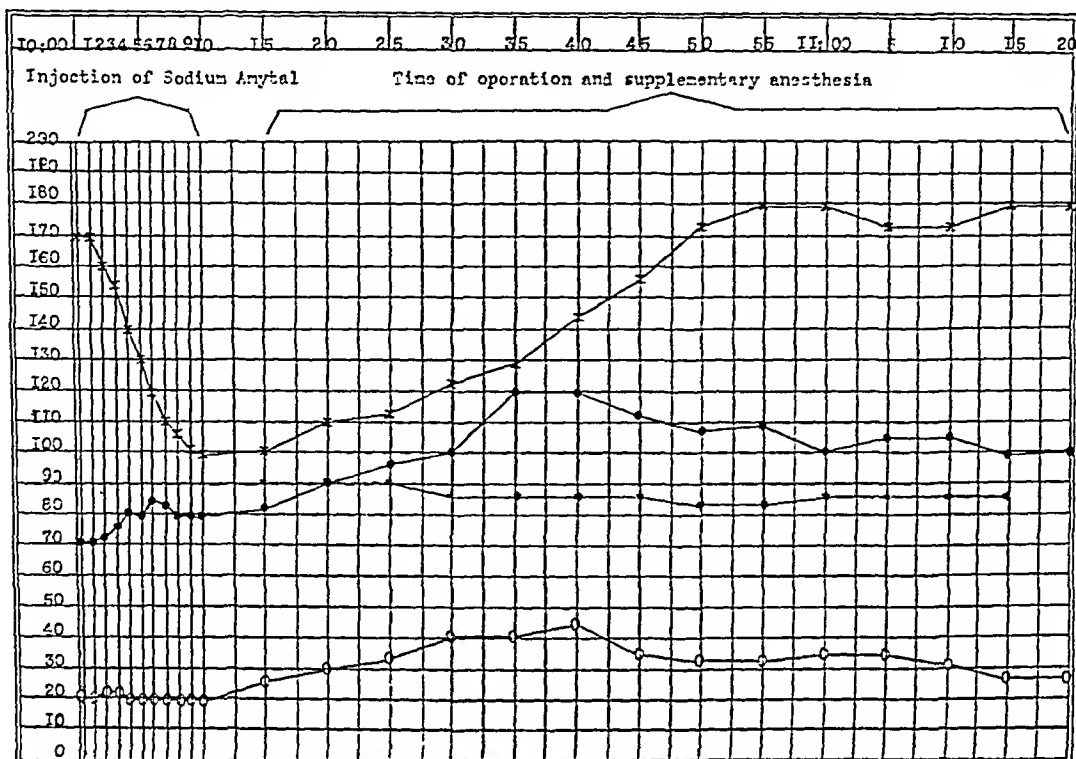


FIG. 2.

tion. It was found that a decrease in rate of injection would often control what appeared as a too rapid decrease in blood pressure. This was especially true in cases of hypertension and arteriosclerosis. Hypnosis was produced in the average case in three to five minutes. The supplementary anesthesia consisted of inhalation of  $N_2O$  gas and oxygen. Administration of 90 per cent  $N_2O$  gas and 10 per cent oxygen was used to obtain complete obtundation, and a reduction of  $N_2O$  gas percentage made to 75 per cent or 85 per cent which still maintained a satisfactory anesthesia. A typical anesthetic chart appears as Figure 1 for patients with normal blood pressure, and Figure 2 represents patients subject to arteriosclerosis or hypertension.

#### IMMEDIATE EFFECTS

The patients seldom manifested fear or nervousness, and many did not realize that they were being given a sleep-produc-

excitation manifested by laughter or logorrhea. All patients experienced the sensation of thickening of the tongue and developed a dysphasia. At this early stage, the patient developed an amnesia, and such patients were suitable for local anesthesia if this type of anesthesia was desired.

Following the stage of dysphasia the patient became unconscious. At the beginning of injection the pulse and respiration were normal. If the mild excitation occurred, the pulse and respiration increased slightly and blood pressure remained normal or showed slight change, and respirations decreased in amplitude. In patients without hypertension or arteriosclerosis the average decrease in blood pressure amounted to 30 mm. of mercury and remained at the new level until the injection was completed. Patients subject to hypertension or arteriosclerosis had an average decrease in blood pressure of 70

mm. of mercury, and this decrease occurred throughout the time of injection. Immediately after administration, the pulse rate showed little or no change, but the respirations were usually more rapid with decreased amplitude. Many patients manifested a slight cyanosis due to relaxation of the throat and tongue and subsequent difficulty in breathing. The blood pressure returned to normal in fifteen to thirty-five minutes, except in cases of hypertension or arteriosclerosis which required from thirty to forty-five minutes. The return to normal was always more rapid if operation was attempted before a complete obtundation by a supplementary anesthetic. Cases of arteriosclerosis or hypertension often developed a blood pressure higher than their preanesthetic blood pressure (see Fig. 2).

#### POSTOPERATIVE TREATMENT

Many patients returned to their room from surgery with an airway or Connell tube in their mouth because of the relaxation of throat muscles. This was removed when the patient first awakened. The first awakening occurred four or five hours after return from surgery. There was a tendency to restlessness following the disturbance of transfer from surgery, but this was easily controlled by small doses of morphine. There were no delirious manifestations in this group. Actual memory and rational consciousness did not return for from twelve to fourteen hours, and during this period of quiet and amnesia, patients received normal saline intravenously or by hypodermoclysis. Patients had no difficulty in retaining retention enemata. Frequent postural changes were given each patient to combat any effect of shallow respiration. Unless contraindicated by the type of operation performed, oral fluids were given freely. Patients were awakened to receive oral fluids, and encouraged to void.

#### SUMMARY

Sodium amytal, as used in this series of cases, did not produce anesthesia, but produced hypnosis, and a supplementary

anesthetic was required. The administration of sodium amytal produced a lowering of blood pressure in all cases, and the decrease was more marked in cases of hypertension and arteriosclerosis. The immediate or remote effect of the blood pressure change was not determined. The relaxation of the throat and tongue produced a temporary cyanosis unless closely watched and an airway or Connell tube inserted. The shallow respiration and long period of quiet after operation was credited with a tendency to pulmonary congestion. Of the first 100 cases, 25 per cent required catheterization, but once the nursing staff became accustomed to awakening sodium amytal patients and encouraging them to void, the percentage was no higher than after other general anesthetics. Urine specimens of all patients were found to contain acetone during the first twenty-four hours. Two patients manifested a bright red rash which disappeared within thirty-six hours. This group included 5 diabetic patients. There was a slight rise in blood sugar, but the  $\text{CO}_2$  combining power of the blood showed little change. One diabetic patient, sixty-six years of age, having hypertension, nephritis, and rapidly advancing gangrene of the lower extremity never recovered consciousness following injection of grain 10 of sodium amytal, receiving less than grain 1 per 20 lb. of body weight. One patient, aged seventy years, having a marked icterus due to stones in the hepatic and common ducts, and a marked hepatic cirrhosis, lived only twenty four hours postoperative. Autopsy revealed only hepatic cirrhosis, and calculi in the biliary radicles. It was assumed that decreased liver function delayed the detoxication and elimination of sodium amytal.

#### CONCLUSIONS

Sodium amytal was not eliminated rapidly, and although use of caffeine and ephedrine would cause patient to regain consciousness more quickly, the action of sodium amytal could not be checked efficiently. Patients having hypertension and arteriosclerosis were given smaller

doses at a slower rate of injection because of the greater change in blood pressure.

Diabetic patients were considered satisfactory anesthetic risks when their diabetes mellitus was under control and the CO<sub>2</sub> combining power of the blood readily obtainable. Decreased liver function was assumed to delay the elimination of sodium amytal; however, this was not proved, and it could not justly be termed a contra-indication. The only idiosyncrasy noted appeared as a bright red rash in 1 per cent of the cases.

More watchful nursing was required during the first twenty-four hours postoperative.

Sodium amytal was obtainable in a form easily prepared for administration. The amount of drug and rate of injection were subject to absolute control to the anesthetist.

The production of hypnosis in patients

in their rooms without excitement and untoward sensations decreased psychic trauma to a minimum. This was considered a salient feature.

Postoperative complaints of nausea and vomiting were absent in 95 per cent of the cases. There appeared to be less paresis of the intestinal tract with subsequent less pain from postoperative gas pains.

The quantity of inhalation anesthetic was reduced. Amnesia without hypnosis was obtainable and with local anesthesia was especially adaptable to minor operations with special reference to cystoscopy.

Use of sodium amytal as the basal agent in combination with inhalation of N<sub>2</sub>O gas and oxygen, with or without a preoperative dose of morphine, produced satisfactory obtundation for all major surgical operations, and was considered to have many advantages not obtainable from other anesthetic drugs.

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\* Continued from p. 293.

# OVARIAN GRAFT IN THE UTERUS\*

G. S. FOSTER, M.D.

MANCHESTER, N. H.

NOW and then there comes into the clinic a woman, single or if married a nullipara, who has a marked pelvic pathology which demands radical operative procedure. In many of these cases we find the pathology of the tubes demanding salpingectomy which sterilizes the patient and makes future pregnancy very doubtful.

Many of these women desire to become pregnant and raise a family at some future date and for this reason they very often express the desire to remain in a condition for future motherhood. Because of the existing pathology, the imperative surgical procedure necessary for a cure and the wish of the patient to remain in a condition which permits pregnancy we are bound to study very carefully these relations in order not only to make a satisfactory operative cure but also to meet the wishes of the patient.

Over a long period of years we have made a survey and study of these cases with the hope of devising some surgical technic which would satisfactorily meet these conditions. During this time we have tried out various ways but until recently have not been in any degree successful. Now we have devised a technic for accomplishing the full purpose of the operation. The technic herein outlined serves the triple purpose and has proved very satisfactory. This uterine intramural, endometrium separation, autogenous ovarian graft technic, has been developed in the clinic as follows.

The usual, low median line skin incision is made and completed into the abdominal cavity. The pelvic cavity is then very carefully surveyed and the pathological structures removed and the entire field carefully dried. The fundus of the uterus is then grasped in tenaculum forceps

and the uterus brought high up into the wound. A cross incision is then made in the dome of the fundus of the uterus between the uterine cornua and this incision is extended in depth down through the endometrium. Each incision of the cross is about  $\frac{3}{4}$  in. long. A blunt hemostat is then passed through this opening and then divulsed thus making a perfect bed for the ovary. The ovary is then pared flat at the four cardinal points and placed in the mural bed in such a way that the unpared convex surface will protrude for at least two-thirds of its circumference through the endometrium of the uterus.

As the ovary is so placed in its new bed the four flattened pared surfaces will come in direct contact with the corresponding four flattened raw surfaces of the uterine wall made by the cross incision. Contact of the corresponding raw surfaces of the ovary and of the uterine wall permits of proper establishment of circulation from the uterus to the ovary thus establishing a complete take.

A No. 1 chromic catgut suture is then passed down through one edge of the uterine walls, then through the exposed surface of the ovary and finally passed up through the opposite edge of the uterine wall. This suture is left untied with the free ends anchored. A No. 1 chromic catgut suture is next passed through each apex of the four triangles made by the cross incision in the uterine wall and this suture is tied and the free ends cut in this way firmly closing the peritoneal surface of the wound in the uterine wall. A suture of No. 1 chromic catgut is also taken in the midpoint between this crown closing suture and the limit of each of the cross incisions. Four of these sutures are taken, tied and the free ends cut. In this way the firm closure of the wounds in the peritoneal

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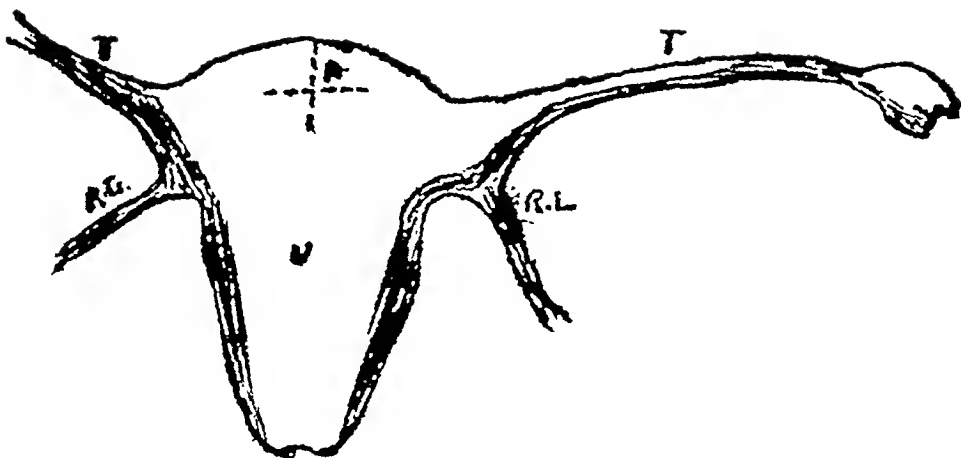


FIG. 1. Location of cross incision in fundus of uterus.

Key: A: Cross incision. U: Uterus. R.L.: Round ligaments. T: Fallopian tubes.

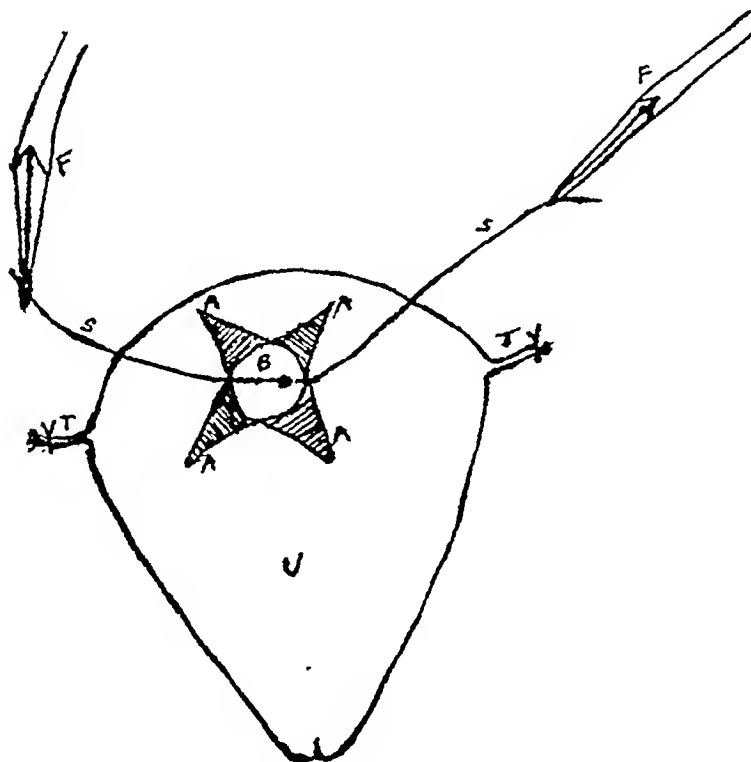


FIG. 2. Cross incision in uterus divulsified with four lines turned out in stellate formation and also center left as bed for receiving ovarian graft.

Key: U: Uterus. A.A.A.A.: Stellate formation of retracted wound. B: Divulsified bed and ovarian graft. T: Stumps of fallopian tubes ligated. S: Anchor sutures passing through open edges of wound and ovary. F: Forceps anchoring anchor sutures.

surface of the uterine wall is assured. The through and through catgut suture which was first made and left untied and

Following the closure of the uterine wound the field is dried, the uterus freed and dropped back into position and the

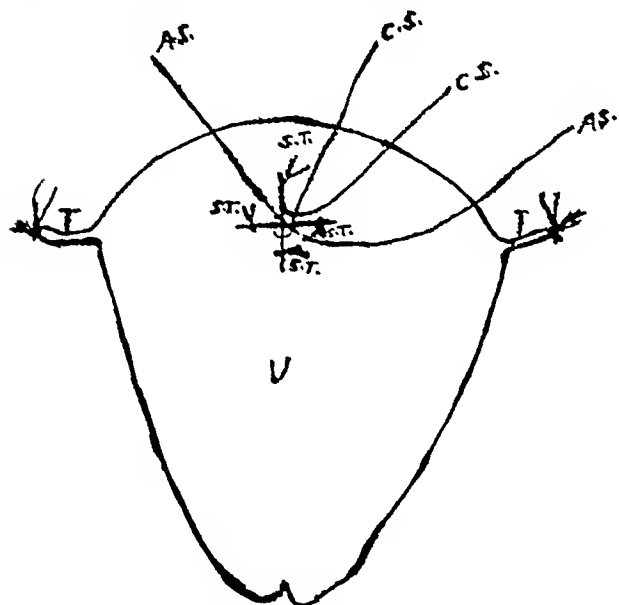


FIG. 3. Cross incision after ovary has been placed in its bed and wound closed.

Key: U: Uterus. τ: Ligated fallopian tube stumps. sr: Four cardinal point sutures closing cross incision tied and cut. cs: Cross incision which includes four apices of angles of retracted stellate flaps ready to tie and cut. as: Anchor sutures ready to tie and cut. (This suture maintains ovary in its bed.)

anchored and which included the ovary is then tied and the free ends cut. This through and through suture anchors the ovary in proper position so that it will not become displaced while a take is made.



FIG. 4.

Key: A: Ovary as removed from patient. B: Same ovary with four cardinal points paired and made flat and raw for insuring perfect take in its new bed.

abdominal wound closed in the usual manner. Not infrequently we place a layer of Cargile membrane over the wound in the uterine wall to prevent any adhesions of other structures to this part. We are using Cargile membrane more and more to cover over intra-abdominal suture lines.

By carefully following the technic as here outlined it will be found that the ovarian graft will make an early and complete take. Any tubal pathology removed which results in the permanent closure of this avenue may be disregarded. Ovulation will be discharged directly into the uterine cavity, pregnancy will occur and the patient cured of her previous condition will be happy in the final result in raising a family.





# TUBERCULOSIS OF THE URINARY TRACT\*

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**T**UBERCULOSIS of the urinary in contradistinction to the genital tract is understood to include the kidney, ureter, bladder and urethra. Like genital tuberculosis, it is always secondary to systemic infection elsewhere, active or latent, in the individual, although it may be an extension or complication of primary genital involvement. Thus when we speak of primary renal tuberculosis, we mean primary only insofar as the urogenital tract is concerned. Furthermore, urinary tuberculosis originating in the bladder, although a theoretical occurrence, is so rare, that if genital involvement can be excluded, evidence of tuberculosis of the bladder may be confidently regarded to be of kidney origin. Tuberculosis, on the other hand, may be limited to the urinary tract, although its proclivity, invariably, is to extend to and involve the genital tract, and vice versa. Walker<sup>1</sup> submits the following figures:

	Per Cent
Kidney primarily involved.....	66
Epididymis primarily involved.....	29
Prostate.....	2
Fallopian tube.....	2
Seminal vesicle.....	0.66
Uterus.....	0.34
Urinary and genital tract together.	37

Young<sup>4</sup> on the other hand in a total of 205 cases of urinary tuberculosis reports a seminal tract distribution as follows:

	Cases
Kidney alone.....	10
Kidney with bladder.....	61
Kidney with bladder and prostate...	14
Kidney with bladder, prostate, and seminal vesicle.....	31
Kidney with bladder, prostate, seminal vesicle and epididymis.....	64
Kidney with bladder, seminal vesicle and epididymis.....	10
Kidney with bladder and epididymis	11
Kidney with bladder, prostate and epididymis.....	4

Thus in about one-third of the cases the infection was confined to the urinary tract, and in two-thirds the genital tract was also implicated.

My report comprises an analysis of 101 cases of urinary tuberculosis in a series of 135 cases of urogenital tuberculosis, from the Polyclinic and Graduate Hospital of the University of Pennsylvania, the Presbyterian Hospital and private practice. Tabulated for the tract and organs involved they appear as follows:

No. of cases of urogenital tuberculosis	135
No. of cases of urinary tuberculosis alone.....	84
No. of cases of genital tuberculosis alone.....	24
No. of cases of primarily renal urogenital tuberculosis.....	101

## INCIDENCE

The total incidence of urogenital tuberculosis is estimated to be about 2 per cent, of which only 0.5 per cent is genital. Of definitely known tuberculous individuals, with active or quiescent lesions, autopsies disclose that approximately 10 per cent have tuberculosis of the genitourinary tract. A review of our cases reveals the well-known facts, that urinary tuberculosis is most often primary in the kidney, irrespective of sex, that urinary tuberculosis is a disease afflicting mostly the third, fourth and fifth decades of life, although 9.4 per cent occurred prior to the twentieth year and 14.9 per cent after the age of fifty. Males were the victims about four times as often as females. In the cases of unilateral disease the right kidney was involved about three times as frequently as the left. A noteworthy fact is that in a considerable number of the cases of renal tuberculosis, the disease had become bilateral at the time surgical treatment was sought. It is my impression that in the past

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decade or two there have been fewer cases of urogenital tuberculosis, in comparison with other genitourinary diseases. This I believe is readily explainable when we reflect that during the past quarter of a century the incidence of tuberculosis in general has dropped from over 200 to 77 per 100,000 of the population. It is to be expected, therefore, that the incidence of urinary tuberculosis must likewise decrease. Nevertheless, it is sufficiently prevalent and unrecognized by the general practitioner to warrant continued emphasis, in spite of the fact that the profession as a whole has been led to the realization that, in the vast majority of patients, urinary tuberculosis is a surgical proposition requiring the services of a genitourinary specialist, although too many family doctors still procrastinate in the treatment of this disease, feeling that they are thoroughly qualified to treat the incipient, slight and insidious symptoms characterizing its early manifestations. Urological surgeons have been largely responsible for the epoch-making advance that has occurred to clarify the pathology, diagnosis and treatment of urinary tuberculosis, and particularly must they not permit the doctrine to gain undue credence that renal tuberculosis is a bilateral affair, and primarily a medical matter. The practitioner or internist must be impressed with the all-important fact that even if he does not need the specialist to assist him in making the diagnosis of tuberculosis, he at least requires him for proper and complete investigation of the case, to decide whether the infection is unilateral or bilateral, and whether it is purely urinary or complicated by involvement of the genital tract. It is difficult for the pathologist, so familiar with the end-result of urogenital tuberculosis, when not only both kidneys and the bladder, but frequently one or more of the genital organs, as well as the lungs, meninges, lymph nodes, bones, and joints are involved, to realize that, early, the only active tuberculous focus resided in one of

the kidneys, and that by surgical removal of this focus, the remainder of the genitourinary tract would not have become involved and the patient's life thereby spared. Such, however, is the fact, and to urological surgery belongs the accomplishment. Therefore, it is not difficult to understand the many laborious efforts and advances that have been made and are being made, to establish the diagnosis and extent of the pathology of unilateral or bilateral renal tuberculosis as early as possible. Thus, urologists, today, are seeing more and more of these patients when the morbid process is confined to one kidney, or more properly, a portion of it, and when, on a five-year prognostic basis, an 80 per cent mortality from the best medical treatment has been converted into an 80 per cent cure by nephrectomy.

#### MODE OF INFECTION

It is universally conceded that the primary origin of urinary tuberculosis is the kidney, excluding those cases where infection is an extension from tuberculosis of the epididymis, seminal vesicles, prostate, uterine adnexa and contiguous processes, as subdiaphragmatic or perinephritic abscess, intestinal tuberculosis, Pott's disease, or rarely when the urethra becomes primarily involved by coitus. It is also unanimously agreed, today, that tuberculosis of the kidney almost invariably arises as a hematogenous infection from the blood stream. There are some, indeed, who insist that this is always the case, denying the possibility of an ascending infection by way of either the lymphatics or lumen of the ureter. With this opinion I am in disagreement and believe that, exceptionally, the infection may reach the kidney through the lymphatic system of the ureter (lymphogenous), or by contiguity, or rarely as a ureteral reflex from the bladder (urogenous), at least possible after pathological changes have occurred about the ureteral orifice. Indeed, in 1883, Semblinow showed by animal experimentation that regurgitation

from the bladder, under normal anatomical conditions, was possible. Young, in 1898, reported failure, by hydraulic distention of chronically infected contracted bladders, to force fluid up the ureters, because of the valve at their lower ends incident to their oblique course through the bladder wall. In 1907 Wildbolz<sup>1</sup> was successful in producing in rabbits an ascending tuberculosis of the kidney, which he ascribed to urogenous, rather than hematogenous or lymphogenous influences. Kretschmer, in 1916, made the clinical observations by cystograms in normal adults and children, some under ether anesthesia, that ureteral reflex occurred in a number of cases. In 1924, Cunningham and Graves<sup>2</sup> reviewed thoroughly the previous work on this subject, adding extensive researches of their own on rabbits, and concluded that "the chief factor in the production of regurgitation lies in the bladder, for the one indispensable requisite without which we have never been able to obtain reflux, is active tone of the vesical musculature"; and that "renal infections . . . can no longer be considered as solely of hematogenous origin. Regurgitation of the bladder contents in the presence of vesical-neck obstruction has been shown to make possible an invasion of the kidney through the ureter from the lower portions of the urinary tract." These deductions have more recently received further corroboration by Player and Ridewill.<sup>3</sup> Nevertheless, in spite of the undoubted occurrence of a vesico-ureteral reflux, in the presence of either normal or pathological intravesical conditions, I question very seriously whether tuberculosis of the kidney ever occurs as a simple urinary reflux from an infected bladder. I am convinced, however, that an ascending infection occasionally takes place via the ureteral lymphatics, and believe the contention can be supported experimentally, clinically and pathologically. Steinke,<sup>5</sup> Stewart<sup>6</sup> and Sweet<sup>7</sup> from 1909 to 1914 in a series of animal experiments showed, rather conclusively, by transplantation of the ureters into the

intestinal tract: (1) that an extensive system of lymph vessels and channels exists in the mucosa, submucosa and external coats of the bladder, ureter and entire structure of the kidney, and that this ureteral network of vessels anastomoses freely with the lymphatics of the bladder below and kidney above; (2) that ascending infection travels through this lymphatic network and not through the blood vessels or lumen of the ureter.

#### PATHIOLOGY

Tuberculosis of the kidney is recognizable under the following seven anatomico-pathological types:

A. *Tuberculous Nephritis*: This may be either (1) toxic or (2) bacillary. The former is that type of nephritis or amyloid disease occurring in tuberculous subjects, due to the action of the toxins of tubercle bacilli active elsewhere in the body, as Pott's or hip joint disease, or in the opposite kidney or in a cascous part of the same kidney. Under such circumstances, if the toxic kidney is functionally sufficient, and the active tuberculous process is confined to the other kidney, nephrectomy often results in the restoration of health to the one crippled by toxic nephritis. In the bacillary type of nephritis, tubercle bacilli are eliminated from the kidney in the urine during an acute or subacute course, the renal lesions appearing inconspicuous. However, it is probable, that at the time, either a transient cellular infiltration or even a very slight epithelial desquamation or microscopic ulceration is produced, from which the kidney may completely recover, the patient die of intercurrent disease and autopsy fail to demonstrate any lesion, latent or otherwise, in the kidney. Much doubtless depends upon the resistance or immunity of the individual; also the type and dose of tubercle bacilli passing through the kidney, whether avian, bovine, etc. Instead of recovery, as a result of the glomerular or tubular nephritis evoked, the bacilli may become localized, form tubercles and produce the character-

istic forms of renal tuberculosis. Walsham demonstrated tubercle bacilli in the glomeruli and epithelia of tubercles of patients with active tuberculosis, in whom there were no demonstrable histopathological lesions. Foulerton and Hillier<sup>8</sup> infected guinea pigs with the urine from 18 patients with active pulmonary tuberculosis; 9 of the pigs developed tuberculosis, but the autopsies on 3 of the patients whose urines produced pig tuberculosis, failed to reveal evidence of renal tuberculosis. Various observers have reported finding tubercle bacilli in the blood in 90 per cent of patients with active pulmonary tuberculosis. Walsh found tuberculous bacilluria in 82.5 per cent of tuberculous subjects. Fournier and Beaufume were able to demonstrate tubercle bacilli by guinea pig inoculation in almost every case of active pulmonary tuberculosis. It is not difficult to understand, therefore, that tubercle bacilli may pass through the gastrointestinal mucosa without producing any demonstrable lesion, or that cows with active tuberculosis may produce bacilli-laden milk without developing tuberculosis of the udder. Thus it would appear that excretory bacilluria is a definite urological phenomenon, and I am in accord with Wildbolz<sup>9</sup> and others in this belief.

**B. Acute Miliary Tuberculosis:** In this form both kidneys are involved and the affection is simply the counterpart of a general dissemination of the disease. It is not subject to surgical intervention, but is of interest from the standpoint of the much mooted question of bilateral renal involvement. Thomas and Kinsella<sup>10</sup> have claimed that 51 per cent of patients first seen in the Sanatorium had bilateral renal tuberculosis, and Medlar<sup>11</sup> found by experimentation that tuberculous lesions of the kidneys were bilateral in 88 per cent of the animals studied. On the other hand, Wildbolz,<sup>9</sup> analysing more than a thousand patients with renal tuberculosis, found the infection to be bilateral in only 12 per cent. This great disparity must be explained, and I believe can be explained on the

ground that it is improper to compare the results of experimental tuberculosis in animals with the manifestations of the disease in human beings, nor is it probable that the renal evidence of tuberculosis, secondary to acute pulmonary involvement encountered in sanatoria, is analogous or comparable to the clinical type observed in the average ambulatory wage-earner, business man or society matron. In the case of the acute pulmonary victim, there is, routinely, an acute, recurrent tuberculous bacillemia, flooding both kidneys with myriads of bacilli, and were it not for the occurrence of excretory bacilluria, I fear every case would develop a definite bilateral renal phthisis. Fortunately, after a time the kidneys either adjust themselves to the bacillemic onslaught, recover completely or partially, and if the latter, are marked by a unilateral or bilateral tuberculous process, which may become progressive. In the case of the ambulatory patient discovered in the rank and file of humanity, with a dormant, pulmonary, lymphatic or joint tuberculous focus, the bacillemia is slight and infrequent, and a localized process does not develop in the kidney unless some additional factor, as trauma, direct or indirect, supervenes to produce a *locus minoris resistentiae*. Thus I believe that in active pulmonary and other extra-urinary tuberculosis the renal involvement is commonly bilateral and may heal in one or both kidneys under a proper antituberculosis regime. No kidney so diseased should be removed surgically, unless its function is demonstrated to be markedly impaired and its mate is functionally sufficient, and until the active primary process has become quiescent. On the other hand, in the insidiously developing unilateral type of infection, the tuberculous lesion is progressive, it never terminates in cure and is seldom arrested clinically, and early nephrectomy offers a brilliant prospect of cure.

**C. Chronic Miliary Infiltrating Tuberculosis:** The process is unilateral. The tubercles, although they may be disseminated

throughout the parenchyma of the kidney, are indolent and show little tendency to caseation, but on the contrary tend to the formation and proliferation of other new connective tissue resulting in fibrotic or fatty degeneration.

**D. Ulcerative Tuberculous Papillitis:** This type is comparatively frequent, and explains those cases characterized by initial marked and continuous hematuria. The ulcerative process begins on the top, side or at the base of the renal papilla and extends to the adjacent pyramid and calyx, gradually involving the medulla and cortex. Tubercles make their appearance in the pyramids, in the columns of Bertini, and in the cortex under the fibrous capsule, and tend to agglomerate and caseate. Other papillae and pyramids become involved and there is often a conspicuous effort on the part of Nature, through fibrous thickening and contraction of the lower end of the calyx or the column of the pelvis, to close off the tuberculous process. This sometimes extends to the uretero-pelvic junction, resulting in hydronephrosis.

**E. Tuberculous Pyelitis:** Very rarely the tuberculous process will begin in the pelvis or calices of the organ, as tubercles and ulcerations, subsequently involving the kidney proper. It is probable that this type of renal tuberculosis has for its mode of infection an ascending extension through the ureteral lymphatic system. Buerger<sup>12</sup> reports one or two such cases.

**F. Caseo-cavernous Tuberculosis:** In this, the commonest form of the disease, there occurs a deposition of tubercles in the vascular zone between the cortex and medulla of the organ. These foci undergo caseation, become confluent, form cavities and infiltrate in the direction of the pelvis or capsule or both. The latter early shows isolated or conglomerate projecting caseating tubercles; later, the capsule becomes thickened and the kidney enlarged, its exterior appearing lobulated and irregular. The morbid process may be limited to the

parenchyma, occasionally one or more caseous areas with or without the presence of calcification, being demonstrable in the poles of the organ, or it may communicate with the pelvis, implanting tubercles and resultant ulceration in that structure.

**G. Tuberculous Pyonephrosis:** This is simply a terminal stage of the previously described pathological process, in which the kidney becomes transformed into an irregular sac of pus or multilocular intercommunicating caverns distended with purulent material, the result of caseation and liquefactive necrosis of the parenchyma of the organ. Frequently the purulent content undergoes additional infection by other pyogenic bacteria. Perinephritis in one form or another ensues, or the ureter becomes plugged or completely stenosed in about 10 per cent of cases, resulting in that condition known as closed pyonephrosis, also recognized as autonephrectomy, in which the urine and bladder, with the exception of a functionless ureteral orifice, appear normal.

Sooner or later the ureter and bladder become involved. The former at times becomes greatly thickened and capable of abdominal, vaginal, or even rectal palpation. Not infrequently its lumen undergoes stricture formation and may become completely occluded. Braasch<sup>13</sup> states the bladder becomes involved in 31 per cent of cases of renal tuberculosis; in my experience it has shown involvement in 75 per cent of patients. Braasch claims genital involvement in 73 per cent, pulmonary in 28 per cent, bones and joints in 6 per cent and coincident lesions in 71 per cent of cases. The urethra exhibits either acute, subacute or chronic inflammation, non-ulcerative or ulcerative, in practically 100 per cent of patients with vesical tuberculosis. It is likewise involved less frequently in genital infection, and rarely in its penile portion from coitus and tuberculosis of the penis. The living pathology of the tuberculous bladder will be described under cystoscopy.

## SYMPTOMATOLOGY

Consideration of the subject of urinary tuberculosis reveals the fact that there has been little if any advance made during the past seventeen years in the diagnosis and treatment of this disease. In fact there are some evidences of reversion to erroneous conceptions. Accordingly, I shall incorporate freely in this presentation statements made by myself at that time.<sup>15</sup>

Limitation of time will prohibit a complete review of the various subjective, objective, general, local and urinary symptoms and signs leading to a diagnosis of this disease. Owing to the fact that renal tuberculosis, insidious in its onset, is prone to masquerade under remote, vague or misleading symptoms, thereby misleading the general practitioner to institute treatment for lumbago, indigestion, cystitis or a nervous bladder, the importance and significance of a few clinical symptoms must be emphasized. Firstly, the most prominent, commonest and in 90 per cent of cases the earliest symptom of tuberculosis of the kidney is irritability of the bladder. Thus in the male, if tuberculous extension from the epididymis, prostate and seminal vesicles can be excluded, and bladder tuberculosis is established, because of the extreme improbability of the latter being primary, it invariably indicates a descending renal infection; in the female, vesical tuberculosis almost invariably means tuberculosis of the kidney. Therefore any patient complaining of frequency of urination, dysuria and pyuria or hematuria, particularly by day, over a period of several weeks, for no obvious reason, should be suspected of renal tuberculosis and submitted to a routine urological examination, until it is proved to be otherwise. It is scarcely credible that these patients are commonly allowed to suffer for months to many years without insistence upon a proper scientific investigation. These early months of the disease furnish the golden opportunity, when nephrectomy promises 80 per cent of recoveries, as contrasted with 80 per cent of mortality from other methods

of treatment. Secondly, equally misleading are those cases presenting vague or indefinite symptoms, as a slight dull or dragging inconstant lumbar pain, gastrointestinal derangement, loss of weight and strength, a clear urine and a normal bladder. Thirdly, it is undoubtedly true that at one time or another in the course of renal tuberculosis, before the ureter becomes occluded, tubercle bacilli, blood and pus cells can be demonstrated microscopically and bacteriologically. However, when the usual civilian patient reaches the urologist the bacilli are demonstrable in only about 80 per cent of cases. In those cases where the tubercle bacillus is not demonstrable, remembrance of the dictum of Rovsing, that pyuria, in the absence of the common pathogenic bacteria, means tuberculosis, is worthy of serious consideration, irrespective of whether polyuria or albuminuria are associated urinary findings. Such figures as 93 per cent, and that bilateral infection occurs in at least 47 per cent<sup>16</sup> must pertain solely to Sanatorium patients, for these percentages are much too high for civilian practice.

Pain, either renal, ureteral or vesical, tenderness in the costovertebral angle, hematuria, pyuria and palpability of the kidney and ureter are commonly present and not infrequently appear as initial symptoms, or one or all may be absent. The practitioner, who simply treats his case as one of chronic cystitis, weak or nervous bladder, and waits for the development of fever, rigors, sweats, loss of strength and weight and a palpable mass, never present in over 20 per cent of patients, in order to substantiate his diagnosis, belongs to the realm of the honored and innocuous past, we trust.

## DIAGNOSIS

The diagnosis of urinary or more particularly renal tuberculosis is by no means always an easy matter. The bacilli are incapable of demonstration in the urine in about 15 per cent of cases, even by persistent, repeated examinations of

twenty-four hour specimens of urine, employing faultless technic, including guinea-pig inoculations, by the Bloch, intravenous, intraperitoneal or intrahepatic methods. The viability of some tubercle bacilli, after laboratory preparation, is so lessened, that their reproduction in animals is an impossibility; moreover, some strains of the bacilli found in man seem to be non-pathogenic for guinea pigs. Conversely, the presence of these organisms in the bladder or even in the kidney urine does not indicate a true morbid process in the kidney, much less surgical intervention. Excretory bacilluria and vesico-ureteral reflux are actual occurrences. Either at the time of surgical exposure or at autopsy, the tuberculous lesion may be so inconspicuous as to be impossible of recognition by inspection and palpation and difficult of demonstration even by section of the kidney, when tubercles are few, for a single tiny caseous cavern or a small ulceration of one of the papillae is the only discoverable lesion. I have had to resort, on two occasions, to bilateral lumbar exploratory incisions in order to determine definitely which was the tuberculous kidney. Suspected kidneys have been exposed surgically and not removed because of normal appearance, only to manifest advanced tuberculosis later. Thickened, palpable ureters may be absent in tuberculosis and rarely present in chronic pyelonephritis. Renal tuberculosis, occasionally, has been confused or mistaken for closed hydronephrosis, pyonephrosis, chronic pyelonephritis, calculus and tumor.

Certainly, the diagnosis of tuberculosis of the kidney must not rest solely upon the demonstration of the bacilli by smear or guinea-pig inoculations. Indeed it is probable that the expert cystoscopist with a knowledge of the physical condition of patients, can diagnose tuberculosis of the kidney from the bladder revelations just as often as the laboratory bacteriologist. Therefore the diagnosis depends not only upon the clinical symptomatology,

valuable as those observations may be, but also upon bacteriological laboratory measures in conjunction with certain other urological procedures. Unquestionably, the absolute diagnosis of urinary tuberculosis rests upon the demonstration of the tubercle bacillus, or characteristic tissue pathology revealed at operation or discovered post mortem. The localization, degree of involvement and original source of infection are determined by examination of the genitalia, radiography, chromocystoscopy, differential functional kidney tests and occasionally by pyelography, ureteral catheterization and exploratory lumbar incisions.

#### RADIOGRAPHY AND PYELOGRAPHY

Not infrequently, from 10 to 25 per cent of cases, lime salts deposited in the caseated kidney are capable of casting a shadow in the skiagram. Under such circumstances the value of the x-ray in the differential diagnosis of calculus and tuberculosis may be nullified. It would therefore appear that little reliance should be placed upon a possible diagnostic measure that at its best fails to determine the diagnosis in 75 to 80 per cent of cases. However, with the advent of uroselectan our hopes and expectations are running high, and it is not impossible that with this substance injected intravenously, much more will be accomplished in the diagnosis of early calyx and parenchymal pathology, as well as renal functional integrity, than has been the case in the past.

Pyelography, in my opinion, is seldom if ever necessary, and in my experience has never been employed for the diagnosis of renal tuberculosis. Although it may assist in delineating early or obscure pathology, it cannot be said to be without danger, even with present-day pyelographic solutions, and we must admit that real mishaps occurred formerly when the original colloid suspensions were employed. It is admitted that by urographic injections of the renal pelvis, early tuberculous involvement of the calices may be



determined, or other characteristic evidence of pyonophrosis be demonstrated. On the other hand, defective or moth-eaten calices may be easily confused with pyelovenous back flow or filling defects from causes other than tuberculosis. I am very skeptical of the assertion that by pyelography tuberculous lesions have been demonstrated in the other kidney negative for bacilli and normal by function, unless pyelovenous back flow has been excluded. I am, therefore, in disagreement that the pyelogram is a factor of moment in the diagnosis of renal tuberculosis in 27 per cent of cases unless the utility of indigo carmine is disclaimed. I am in hearty accord with the recent conclusions of Kearns<sup>17</sup> that the injection of the kidney after tubercle bacilli have been demonstrated is one of the abuses of pyelography as well as of the patient, yielding no essential information, and that its routine employment is needless, unreliable and dangerous.

#### CYSTOSCOPY

The cystoscope is by far the most important instrument for both the localization of high urinary tuberculosis and, in the majority of cases, for the actual diagnosis of the disease *per se*. I well remember that in the early part of this century, it was taught in a number of leading medical schools and hospitals of this country, although it was permissible in selected urological cases to employ cystoscopy, to pass a cystoscope in a tuberculous bladder was a homicidal act. Times have changed, for today many world-renowned urologists do not hesitate, but insist that catheterization of a normal ureter in the presence of tuberculous cystitis is a harmless procedure. It frequently happens that the cystoscope reveals an intravesical picture pathognomonic not only of tuberculosis of the bladder but also of the kidney above, primarily affected. Thus we are in a position to determine in most instances; (1), whether or not tuberculosis exists (2), the degree or extent or involvement by

resorting to indigo carmine and chromoureteroscopy and (3), whether only one or both kidneys are involved.

The living pathology of the bladder commonly associated with renal tuberculosis may assume various appearance. During the incipency of the disease, before gross tissue changes and suppuration occur, and while the kidney is still functionally sufficient, the process consisting simply of a bacillary nephritis, the bladder lesions by cystoscopy may appear inconspicuous. At other times, and particularly if a mixed infection supervenes, the ureteral orifice appears inflamed and swollen and a general acute cystitis is associated, occasionally almost obliterating the crateriform openings of the ureters. Buerger has recommended the excision of a portion of the ureteral orifice mucosa through the cystoscope and careful examination of the same for tubercle bacilli. The recommendation is certainly not without objection and I have failed in an extended experience to discover a single case in which the procedure was warranted or necessary. The presence of the disease in the bladder is characterized by inflammatory evidence of the ureteral orifice, as the infection infiltrates the mucosa and submucosa; it begins to assume rigidity, losing its peristaltic activity; ulcerations and rarely miliary tubercles can be noted not only in the region of the ureteral orifice of the affected side and trigone, but throughout the mucous membrane, even on the lips of the ureteral orifice of the normal side; bullous edema of the mucosa about the orifices or in the trigone is frequently observed. As the process continues, the orifice becomes markedly infiltrated, enlarged and retracted; often the appearance is that of an open sewer-pipe pouring a stream of pus into the bladder. Not uncommonly, the ureter becomes completely occluded by semi-solid casts of pus, or undergoes stricture formation, resulting in atrophy of the orifice; in such a condition there may be neither pyuria nor tubercle bacilli in the bladder urine.



Oecasionally, irregular granulomata form in the bladder. In the final stage of the disease all vesical landmarks become effaced and the bladder wall is simply an expanse of confluent deep ulcerations covered with blood coagula and exudate. If it is impossible by cystoscopy or chromoureteroscopy to determine the respective kidneys, recourse should be had to bilateral exploratory lumbar nephrectomy to determine the relative integrity of the two organs. In a few rare instances, by the adoption of such measures, the more involved of the two kidneys has been removed with temporary benefit, but never unless by indigo carmine, the lesser involved was found to be functionally sufficient, and the involvement presumably in its earliest stage. Such a procedure is seldom, if ever, indicated, and when nephrectomy is performed in the case of bilateral infection, the patient invariably dies in less than a year. At the Mayo Clinic the longest reported life was a year and a half. I have observed a patient who at the time of her original examination demonstrated bilateral tuberculous involvement of functionally insufficient kidneys. Under a strict anti-tuberculous regime, including tuberculin, one kidney was restored to normal function after two years and nephrectomy of its severely diseased mate resulted in the patient's complete restoration to health, now for a period of over ten years.

#### FUNCTIONAL KIDNEY TESTS

Those commonly employed are indigo carmine and phenolsulphonephthalein, and I suppose now we will have to add uroselectan, possibly according it first place. However, for the present, I utilize and prefer for surgical purposes, indigo carmine by the method of chromoureteroscopy, or as some prefer to style it, cystoscopic meatoscopy, and believe this is the field per excellence for this test, superseding all others.<sup>18</sup> In thousands of observations by this technic, the interpretations with respect to diagnosis and prognosis have been almost infallible. Indeed, from the

standpoint of renal tuberculosis, and illustrative of my faith in and dependence on indigo carmine, my routine practice is to regard the patient or his kidney one for medical rather than surgical treatment, if the elimination of the dye is retarded beyond the functionally sufficient time limit, which experience would indicate is ten minutes after intravenous injection. Notable exceptions have been observed only in 2 instances; when from the sound kidney no visible dye was eliminated, while from the diseased side it was freely admixed with the tuberculous pus; following nephrectomy the dye was eliminated normally from the remaining kidney. This phenomenon is difficult to explain, unless it be due to reflex or toxic inhibitory influences on the renal function, exerted through the sympathetic nervous system, analogous to the crossed renal expressions of pain.

It is surprising to observe frequently, how small a tuberculous process in the kidney will inhibit and delay beyond the normal time period, the excretion of indigo carmine. Can this also not be due to reflex or toxic effects influencing the function of the kidney? Similar sized lesions of other renal diseases do not produce such results.

Other points of superiority of indigo carmine over phthalein and other functional tests are, that it renders ureteral catheterization for the purpose of determination of unilateral renal sufficiency unnecessary, and that it aids materially in some cases in the localization of the ureteral orifices, the catheterization of which, otherwise, may be a physical impossibility.

#### URETERAL CATHETERIZATION

Allusion has already been made concerning the harmfulness of ureteral catheterization of the normal side in the presence of tuberculosis of the bladder. Personally, I am unreservedly opposed to the practice, believing that the management of the case can be just as well, if not better, carried out by avoidance of catheterization of the good ureter, with reliance placed upon indigo carmine to differentiate the involved

kidneys, and see no reason for a reversal of attitude until the harmlessness of the act, by furnishing better results than we are accustomed to see, clinically, is proved. There can be no objection to catheterization of the diseased side; indeed it possesses the merit of determining the presence and position of strictures, when they exist, important information for the surgeon at the time of nephro-ureterectomy. It cannot be denied, there exists at least a potential danger of implanting tubercle bacilli in the ureter by catheterization in the presence of tuberculous cystitis. Certainly, I should not permit the practice upon myself, and this is a proper consideration to extend to patients. Therefore, if the danger cannot be denied, what is to be accomplished by performance of the act? Assuredly, the finding of tubercle bacilli in the ureteral catheterized urine does not mean necessarily that a surgical lesion exists in the respective kidney, or that it is functionally insufficient, or that the bacilluria is doomed to be permanent. Again, it is quite possible that the bacilli, discovered in the catheterized urine, may have been carried into a normal ureter from an infected bladder by the catheter itself. Finally, a negative finding does not by any means exclude the possibility of tuberculosis in the suspected kidney, for in the technic usually employed, the catheter is allowed to remain in situ but fifteen to thirty minutes, and it is well-known that even in a twenty-four specimen of urine failure to demonstrate the tubercle bacillus is not unusual. Thus on one side of the scales there may exist erroneous findings, while on the other there is potential danger. If one kidney is functionally sufficient and its mate is insufficient, operation with a view to nephrectomy on the affected side should be done, irrespective of the demonstration of the tubercle bacillus, which is of little moment under the circumstances. If the disease has remained unilateral, which will be the case in the vast majority of patients, the urologist will enjoy the satisfaction of knowing that he is not responsible for the

production of infection of the healthy kidney by unnecessary catheterization.

#### PROGNOSIS

Wildbolz<sup>9</sup> in a recent review of over 1000 cases of renal tuberculosis, including 660 nephrectomized patients, claims an operative mortality of 2.2 to 2.5 per cent, and complete cure over a period of ten to twenty-five years, in 59 per cent. Of these, only 3 patients had persistence of cystitis or evidence of urogenital tuberculosis for a longer time than two to five years after operation. Braasch<sup>13</sup> reporting the statistics of the Mayo Clinic, finds an operative mortality of only 1.3 per cent in 516 nephrectomies for tuberculosis, failure to effect complete cure in approximately 20 per cent up to five years after operation, and a complete cure in fully 60 per cent of patients; also that 55 per cent of patients who were failures died in less than a year after operation, the mortality rate thereafter decreasing inversely proportional to time after operation. Bugbee<sup>21</sup> reported no mortality in a series of 38 cases for the first five years after operation. The immediate mortality, therefore, seems to be a negligible factor, even in my own insignificant series, 47 cases being also nil. The report of Wildbolz is also interesting in that only 20 per cent of his cases died of involvement of the other kidney or pulmonary tuberculosis. Other deaths in order of frequency were due to miliary tuberculosis, tuberculous peritonitis, enteritis, spondylitis and solitary tubercle of the brain. Not less than 15 per cent of deaths were due to intercurrent diseases, some in the absence of any evidence of urogenital tuberculosis.

In those exceptional cases of bilateral involvement, where nephrectomy rarely is advisable, permanent recovery of the remaining kidney will not follow, and the prospect of life at least will seldom be over a year.

Operation should not be undertaken in the presence of active pulmonary tuberculosis, but may be advisable in spite of other coincident lesions, provided they are not too extensive or active, but always with

reservations. The best results will be obtained in the unilateral cases of early involvement, and those with closed ureters, where the infection is not widespread through the urogenital tract. There is a definite spontaneous tendency on the part of the bladder and lower urogenital tract to undergo gradual resolution and recovery, sometimes requiring years, after the tuberculous kidney has been removed. In advanced bladder involvement the mortality of nephrectomy is twice as high as in the early forms, and the persistence of bladder symptoms after operation is directly proportional to the duration of their presence previously. In recent years propaganda has been circulated to observe a watchful waiting policy for the development of the patient's resistance in case of renal tuberculosis. This may be good doctrine in Sanatorium practice in patients with active pulmonary processes, but I believe it to be a dangerous idea to put over to our medical friends and the profession generally, since it is universally recognized that fully one-third of tuberculous kidney cases exhibit healed or quiescent pulmonary lesions. Although some early cases may manifest a stormy convalescence after nephrectomy, dallying as to treatment or procrastination is inexcusable and leads but to the grave.

Pregnancy does not necessarily contraindicate nephrectomy. I have performed it twice successfully in renal tuberculosis.

Contrasted with these results, palliative or medical treatment offers little or nothing. Wildbolz<sup>19</sup> analyzed 316 cases of tuberculosis of the kidney, treated non-operatively, with and without tuberculin, under the best climatic and heliotherapeutic conditions in Switzerland, and found that 70 per cent died within two years, and only 10 per cent lived longer than five years after the onset of symptoms, and the few survivors after apparent cure all had a relapse sooner or later and died.

#### TREATMENT

Statistics compiled from patients who present themselves for treatment of renal tuberculosis, demonstrate that about three-

fourths have symptoms dating back more than a year, and that only 10 per cent consult the urologist within six months of the onset of symptoms. The pertinent question therefore arises: Why are these patients prevented so long from receiving surgical aid? The answer seems to be, firstly that either the patient because of the insidious onset of the disease, or the physician misled by the vague or remote symptoms, fails to appreciate the danger of the fire with which he is playing, and the value and importance of early operation; secondly, there appears to exist in some localities in the minds of doctors, who ought to know better, a prevalent opinion that nephrectomy is not the best treatment for unilateral tuberculosis of the kidney.

Treatment of urinary tuberculosis is both *operative* and *palliative*. Early nephrectomy with partial ureterectomy, or aseptic nephroureterectomy,<sup>20</sup> through the usual lumbar incision, removing the ureter down to or below the lowermost stricture, if any be present, is the procedure of choice in all cases of unilateral renal tuberculosis and rarely in a few cases of bilateral involvement. The choice of anesthetic is a matter of great importance, and preference should be given to spinal anesthesia or nitrous-oxide gas or ethylene. Occasionally, in a few cases of bilateral involvement that become operable, preliminary antituberculous treatment will be necessary until the activity of the extraurogenital or urinary process has subsided, and the patient's general resistance or immunity has been established. In those cases of urinary tuberculosis originating in genital sources, the epididymis will be found to be the chief offender, and its removal, just as in the case of the kidney, by eliminating the primary urogenital focus of infection, will, as a rule, permit the complicating involvement of the ureter, bladder, urethra and seminal tract to undergo resolution, requiring in many instances, however, months or years. The ureter should be severed between ligatures or clamps by the cautery knife and the stump carbolized, dropped, and the wound closed with a tubular drain.

Complete nephroureterectomy, including a portion of the bladder wall, unduly prolonged the operation, and failed to measure up to expectations, so far as prevention of sinus formation is concerned. Partial or heminephrectomy was never widely adopted, because all the involved renal tissue was not always removed, necessitating subsequent operation; so, today, the only radical procedure on the kidney for tuberculosis, should be total nephrectomy. No advantage and some disadvantages have followed filling the wound with saline solution and closing it without drainage. Lumbar sinuses result in about 10 per cent of cases and may persist for weeks or a year or more. The discomfort from persistent cystitis may be ameliorated, and the recovery from the tuberculous process in the bladder greatly promoted by tuberculin and methylene blue and intravesical injections of carbolic acid, 6 per cent, 30 c.c. every four to six days (Rovsing), gomenol, guaiacol, iodoform, metaphen and mereurochrome; also x-ray therapy, the mercury vapor quartz lamp

and heliotherapy, properly administered, are beneficial, but unless carefully supervised, may do harm; in some cases of ulceration and granulomatous formation, cystoscopic fulguration has been very useful.

Of paramount importance in all cases of tuberculosis is the consideration of the best hygienic and dietetic conditions attainable. Transference of the patient to a high, dry atmosphere, such as exists in certain parts of Colorado, New Mexico and Arizona, is ideal although usually impossible. No surgeon has done his full duty when he simply removes the kidney, and permits the patient to return to his former life, habits and environment.

Palliation, with or without tuberculin, has a definite place in the treatment of urinary tuberculosis, and should be reserved postoperatively and for the bilateral, inoperable cases with active foci in the lungs, lymph nodes, peritoneum, bones and joints; also for the cases of indefinite bacilluria and functionally sufficient kidneys. Here all that has been said about hygienic treatment applies, even more forcibly.

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# A NEW UROGRAPHIC MEDIUM: EMULSIFIED CAMPIODOL

(AN IODIZED RAPESEED OIL\*)

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RESEARCH studies in the field of urography have shown increased activity in recent years. The successful introduction of the halogenated oils, especially the iodized oils, for diagnostic visualization in urologic radiographic procedures has led to satisfactory results. The recent introduction of intravenous urography cannot for the present time, at least, hope to displace the time-proved procedure of uretero-pyelography performed from below. The successful use, since October, 1928, of an iodized oil, emulsified campiodol, has led to gratifying results in all parts of the urinary tract, and it is for this reason that the writer wishes to make a further report.

Since the introduction of lipiodol, an iodized poppy-seed oil, by Sicard and Forestier in 1923, these compounds have come to be more extensively used for diagnostic purposes in the various systems of the body. Only in the last one and one-half years has the use of iodized oils been really successful in the urinary tract. Up until that time iodized oils, though casting satisfactory shadows, gained but little favor in urography because of their failure to meet the prerequisites of a good urographic medium. Their increased viscosity and non-miscibility with the urine were found to be great disadvantages. The viscousness of such oils did not permit a ready flow into the kidney pelvis unless great pressure could be exerted, the use of special syringes being advised. Adherence to the pelvic and ureteric mucous membrane prevented ready drainage, resulting in obstruction and pain. Air accidentally introduced might produce a trap with a similar consequence. The non-miscibility often gave distorted pyelograms, hindering correct diagnosis.

Iodized oils have, however, properties

desirable for a good urographic medium. Their non-irritation or lessened irritation and very low toxicity due to their inertness as chemical compounds are of value. The more widely used 12½ per cent sodium iodide, while possessing many advantages as a pyelographic medium, is an electrolyte and therefore in some instances irritating to the urinary mucous membrane. This has led urography to be a distressing procedure in many cases.

While the primary object of urography is to visualize the urinary tract so as to demonstrate the normal and abnormal conditions, the comfort of the patient during a cystoscopic study should be considered. Cognizant of these facts, we wished to utilize the iodized oils because of their desirable properties, and consideration was given to solving their shortcomings, namely, the non-miscibility and high viscosity. The desirable properties were at once apparent, for by the use of emulsified campiodol, a mixture of campiodol (iodized rapeseed oil) acacia and distilled water, the pain, burning and irritation were completely eliminated and the problems of high viscosity and non-miscibility satisfactorily solved.

Campiodol, or iodized rapeseed oil, was synthesized by Frazier and Glaser, with the aid of Dr. George Raiziss, in their search for a suitable substance in cerebrospinal visualization. It is a light yellowish product with a specific gravity of 1.289 and an elemental iodine content of approximately 44 per cent. Campiodol deteriorates very slowly from light and heat and upon radiographic exposure casts an intense shadow, so much so that dilution products may readily be made without destroying its clinical value. Experimental studies by Frazier and Glaser have shown it to be of very low toxicity in spinal, cisternal,

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FIG. 1. Bilateral normal pyeloureterogram in vertical position with emulsified campidol. Note excellent shadow cast as to radiographic intensity and definition.



FIG. 2. Same case as Fig. 1 with 12.5 per cent sodium iodide as urographic medium.



FIG. 3. Normal pyelogram made with emulsified campidol.

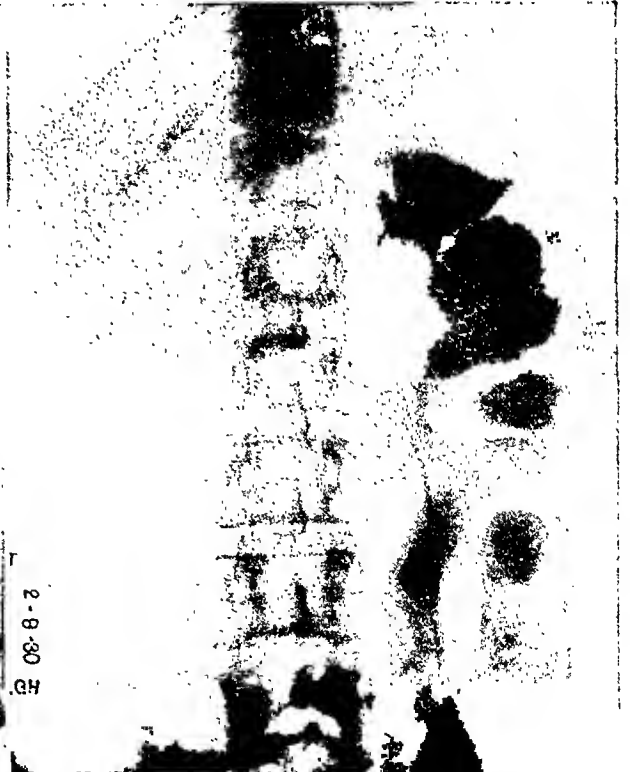


FIG. 4. Huge hydronephrosis and hydroureter demonstrated in an eighteen-year old male patient with 650 c.c. emulsified campidol. F 10 ureteral catheter in place and pyelogram made by gravity method. (Courtesy of Dr. R. V. Day.)



FIG. 5. Pyelogram made with emulsified campiodol and showing tuberculous pyonephrosis.



FIG. 6. Pyeloureterogram made with emulsified campiodol, showing atrophic hydronephrosis and multiple ureteral strictures.

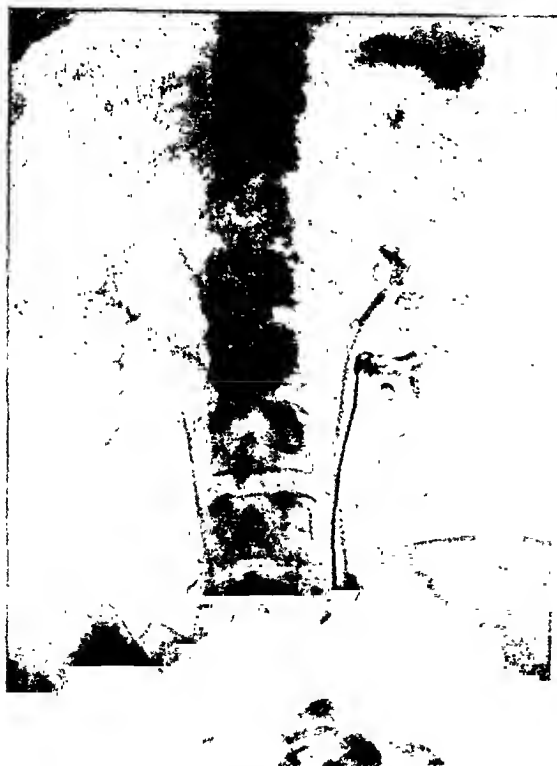


FIG. 7. Pyelogram with emulsified campiodol demonstrating double kidney and ureter. Right kidney pelvis outlined very lightly because of insufficient campiodol emulsion.



FIG. 8. Urethrogram made with campiodol emulsion showing definite single stricture in anterior urethra.



ventricular and vascular injections, as well as by oral administration. Further experimentation showed that by emulsify-

renal pelvis or ureter must be guarded against so as not to produce the colicky pain from such a source. Cases have been



Fig. 9A is campiodol emulsion cystogram showing irregular outline due to cellulite formation.



Fig. 9B is air cystogram showing diverticulum retaining emulsified campiodol. Close inspection of both illustrations shows outline of prostate bulging into bladder.

FIGS. 9A and B. Contrast cystograms in case of prostatic hypertrophy using emulsified campiodol.

ing campiodol with an acacia solution, a stable compound of low viscosity and good miscibility could be obtained. It is this mixture that has given satisfactory results as an urographic medium from both the patient's and the urologist's point of view.

Emulsified campiodol is a stable, grayish-white oil emulsion, having a specific gravity of 1.078, a viscosity slightly more than twice that of water, non-irritating, very low toxicity and casting excellent roentgenographic shadows in solutions varying from 7 per cent to 10 per cent iodine content. By its use have been eliminated such disadvantages from 12½ per cent sodium iodide as pain, burning and other signs of discomfort and irritation. Nevertheless, over-distention of the

noted in which there was no complaint of pain or irritation with the emulsified campiodol. The emulsion was permitted to drain out, and a second pyelogram with 12½ per cent sodium iodide was almost instantly productive of a burning pain in either the lumbar or vesical regions, which in some instances continued for several hours. The performance of urography in the lower urinary tract (cystograms and urethrograms) has become a benign procedure with the complete elimination of all consequent symptoms of pain, burning, urgency and irritation as is nearly always noted with the use of 5 per cent and 12½ per cent solutions of sodium iodide in the bladder and urethra respectively.

Emulsified campiodol has been success-



fully used in all parts of the urinary tract in over 250 cases. Clinical experience has shown it to give pyelograms, ureterograms, cystograms and urethrograms equal to 12½ sodium iodide and superior to other iodized oils. The shadow-casting properties have been excellent in people of all weights. The emulsion is miscible with water in all dilutions and therefore mixes readily with the urine, making it possible for the medium to gain access into all crevices or openings of the urinary tract, thereby giving excellent definition. The withdrawal of the ureteral catheters into the lower ureter for injection has resulted in excellent ureterograms. The viscousness of the emulsion being twice that of sodium iodide has made possible excellent urethrograms according to the technic of Braasch.

The syringe method has been used in nearly all cases since the emulsified campiodol is as yet too viscid for the gravity method. Exceptions to this were cases of patients in whom F 10 ureteral catheters had been introduced making possible the gravity method. For those who wish to have accurate control of the injection during the making of a pyelogram or ureterogram, the use of a correctly calibrated and certified manometer or pressometer as advocated by Pugh is suggested. The emulsion has been found to drain out quite readily from the injected pelvis and ureters, thereby eliminating the possibility of obstruction and renal pelvic retention as caused by other iodized oils. Complete withdrawal of the ureteral catheters has

shown by x-ray that there is ready drainage from the kidney pelvis except in cases of ureteral obstruction or slow urinary secretion.

#### SUMMARY

Campiodol is an iodized oil (rapeseed oil) containing approximately 44 per cent elemental iodine. To adapt it to urographic use, a stable emulsion was made, using campiodol, acacia and distilled water. This results in a mixture containing 10 per cent to 11 per cent elemental iodine, making it equal to sodium iodide for roentgenographic use.

Emulsified campiodol as an urographic medium is miscible with water (urine), of lowered viscosity, inert, non-toxic, non-irritating and casts excellent roentgenographic shadows as to detail and intensity in all parts of the urinary tract. It has been used in over 250 cases with a minimum of irritative symptoms and therefore possesses some advantages over 12½ per cent sodium iodide in urography.

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# REGIONAL ANESTHESIA

AS APPLIED TO UROLOGICAL SURGERY\*

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THERE has been an increasing dissatisfaction in recent years with the use of general anesthetics as evidenced by the many newer methods of inducing anesthesia both here and abroad. This is particularly true in urology because often one of the organs of elimination is damaged or destroyed, making the choice of the anesthetic doubly important. More thought has been given to the patient as an individual instead of considering him a lesion, a disordered mechanism, or an interesting case.

We no longer feel that our duty as surgeons is to render the patient senseless to pain and return him to his bed alive after the operation. A patient undergoing an operation deserves the anesthesia as well as the surgical procedure which will prolong his life. The surgeon should not consider whether these methods require greater study or skill but should be willing to master any technic for the welfare of the patient.

The practice of regional anesthesia has been an impetus to anatomical study and the art and science of surgery have greatly benefited by it. The anesthesia of choice is one which combines mental relaxation and relief of pain in the operative area. Our aim is to obtain these with the minimum risk to the patient.

Regional anesthesia, particularly for urological patients, combined with some preliminary medication to relieve fear and apprehension when they are present, seems to be the safest method at our disposal. There is a definite percentage of mortality from the use of any inhalation anesthesia at the time of operation, but by far the greatest death rate occurs from one hour to a week following the anesthesia.<sup>7</sup> These deaths are caused by shock, abdominal

distension, ileus, acute dilatation of the stomach, lung abscess, pneumonia, albuminuria or suppression of urine, and are mostly attributable to the use of a general anesthetic. Our experience with spinal anesthesia in a small series of cases has been unfortunate, for we had two fatalities which were at least partly caused by the anesthetic. Other surgeons have been more fortunate in the use of spinal anesthesia but we believe that regional anesthesia is safer. Shock, gastrointestinal disturbances, pulmonary complications and impairment of renal function are all greatly diminished under regional anesthesia. The blood pressure remains more nearly constant than in spinal anesthesia. Patients are permitted to take fluids before, during, and immediately after operation.<sup>12</sup> Furthermore, it is possible to perform all urological operations under regional anesthesia.

In operating under regional anesthesia, the surgeon should use sharp dissection and cutting which minimizes the trauma to the tissues. Pulling, tearing or bruising the tissues are sometimes felt by the patient. This necessity for gently handling the tissues makes us better surgeons. The relaxation of the muscles under regional anesthesia is more complete.

The conception of the function of an anesthetic has changed in recent years. The ideal anesthetic not only abolishes pain during the operation but also relieves the patient of the fear or dread of the ordeal. The importance of this fear has been proved by Crile,<sup>2</sup> who has shown that exhaustion from nervous energy is actually capable of producing shock. If this dread can be overcome by the use of some sedative which is safe, we will have made considerable progress in the field of regional anesthesia.

\* Read before the Urological Section of the New York Academy of Medicine, May 21, 1930.

## PRELIMINARY MEDICATION

Before one is justified in using a drug in urology to relieve the fear of a patient, it is necessary to know something of its pharmacology. We must know where it acts, where it is destroyed and, most of all, in what form and how it is excreted, so that an additional burden will not be added on the urinary organs. We have used morphine in some of our operations since Haines and Milliken<sup>6</sup> have proved that morphine in the usual hypodermic dose does not affect kidney function. However, morphine does not obtain the desired mental relaxation. Bartlett<sup>1</sup> advises the use of luminal, using 12 to 30 grains by mouth, given in one dose (usually 15 grains). He states that (1), there is voluminous clinical and experimental literature without a single authenticated death from its use (although single doses of 50 grains have been reported twice); (2), it causes less nausea and loss of equilibrium than veronal; (3), the needle pricks of the anesthesia are not noticed. He also states that its effect lasts from twelve to twenty-four hours, the reflexes are not interfered with, and there is rarely vomiting or sweating from its use. Luminal has been used successfully to counteract procaine intoxications which occasionally occur. Landy<sup>12</sup> has used sodium amytal in various doses but states that patients often become delirious for a day or two, sometimes requiring actual restraint. We are trying luminal in a few selected cases but can give no opinion at present.

## DRUGS

Much experimental and clinical work has been done with procaine so that we can anticipate its effect and realize its dangers. Einhorn discovered procaine in 1905. Piquand and Dreyfus<sup>16</sup> have shown how the speed of injection and the strength of the solution are the two most important factors in the toxicity of procaine. Eggleston and Hatcher<sup>3</sup> have proved that a fatal dose may be injected intravenously without any ill effects, provided it is

injected in a dilute solution and twenty minutes are consumed in its administration. Furthermore this same fatal dose may be repeated every twenty minutes, showing that this rate of elimination continues and that there is no accumulation. Procaine is destroyed in the liver and undergoes oxidation before its excretion from the kidneys, thus adding no additional burden on the urinary organs.

The injection of a small amount of a strong solution of procaine may cause more serious symptoms than several times that amount of the drug in a more dilute solution.<sup>2</sup> Thus a 3 per cent solution is much more than three times as toxic as a 1 per cent solution. It is preferable to use the most dilute solution of procaine possible to obtain anesthesia, because it is the least toxic, even though more of the actual drug must be used. For this reason we use 1 per cent procaine for all regional anesthetics, experience having shown us that weaker solutions do not produce sufficient anesthesia, since we do not desire to use stronger solutions because of the additional toxicity, which is out of proportion to its benefits. Our procaine solution is always freshly prepared and sterilized the day it is to be used.

Experimentally as much as 12.5 gm. of procaine per 100 lb. body weight may be injected subcutaneously without fatality, provided it is injected slowly and in a dilute solution.<sup>5</sup> One would certainly not use this amount, since more than 1.5 gm. of procaine in a 1 per cent solution is rarely needed to produce anesthesia. There is no harmful effect upon the tissues from the injection of 1 per cent procaine solution. Adrenalin is not used because it is not necessary for the anesthesia, some accidents have occurred with its use, and by using it another toxic element is added which the patient must combat.<sup>17</sup>

Other drugs are being used for regional anesthesia. Some of them are proving very satisfactory. However, we feel that procaine has experimentally and clinically been proved to be safe and efficient. We

must wait, therefore, until sufficient experimental work has been done on other drugs before we should try them clinically.

#### INDIVIDUAL VARIATIONS

The threshold of painful stimuli varies considerably with individuals. Either the actual pain from external stimuli is registered differently or the patient's mental stolidity prevents him from showing any signs of pain. Young people apparently are more sensitive to pain than older ones. An understanding of the procedure with complete confidence in the surgeon seems to render the patient less sensitive to pain. Excitement and fear actually seem to be factors causing patients to suffer greater pain. Cowardice may be a factor in certain cases. A variation in the actual pain experienced is also noted in race, sex and mode of living of the patient, as well as with those of asthenic stature, or those debilitated by some long illness. Without attempting to explain or understand the cause of these variations, we must admit that the pain actually felt or experienced by patients is not constant under the same conditions.

It is because of the variations of the pain actually experienced that we are beginning to use a preliminary mental sedative for certain individuals. This is not given to relieve the pain in the operative area nor as a substitute or aid for the regional anesthesia. It is used to allay the excitement, fear, anxiety, or other mental reactions which may cause the patient to remember his operation as a terrible ordeal. The regional anesthesia is sufficient to relieve pain locally but if the patient's burden from fear and apprehension could be lifted, we would feel that a better anesthesia had been induced.

The amount of procaine solution necessary to produce anesthesia also varies with individuals. This is particularly true in sacral anesthesia although it can be noted elsewhere. Anyone who uses an exact amount of a solution of procaine for all sacral anesthetics will either experience

some failures by using too little or some avoidable toxic reactions by using too much. There are many factors which may account for this. The actual size of the sacral canal, which must be filled with solution, is different in individuals. The action of procaine is physico-chemical, the nerves actually taking up the solution.<sup>4</sup> The permeability of the nerves is another important variable factor. The rate of absorption into the general circulation varies. A certain amount of the procaine solution passes out of the sacrum through the lateral sacral foraminae with the nerves.

Supposing we are given a patient with a small sacral canal, with nerves of high permeability so that the procaine is rapidly absorbed by the nerves, with very slow absorption into the general circulation, and small lateral sacral foraminae so that only a negligible amount of solution will pass out through these. We would expect to obtain an anesthesia in this patient with a relatively small amount of procaine solution. The addition of more solution might cause the rupture of a blood vessel and rapid absorption into the general circulation, or the solution might separate the dura from the bony canal and extend upward. Either of these would cause toxic symptoms.

Then supposing we have a patient with a large sacral canal, with nerves of low permeability so that the procaine is very slowly absorbed by the nerves, with more rapid absorption into the general circulation and large lateral sacral foraminae, so that considerable solution passes out of the sacrum before the nerves can absorb it. This patient would require a relatively large amount of solution to obtain anesthesia. If a smaller amount of solution was used, the anesthesia would not be satisfactory.

These theoretical cases are the extremes but it is well to keep in mind the various factors which may influence the success of regional anesthesia. Fortunately these variations may be present in any combina-

tion and to any degree. However, they show that one cannot expect perfect results by following a definite technic without any variations. We have obtained perfect anesthesia by using 20 c.c. of 1 per cent procaine solution in the sacral canal combined with transsacral nerve-block. In other patients it has been necessary to use as much as 100 c.c. for anesthesia.

There are very few guides to tell us how much solution we should use in a given case, and none of these is as important as experience. In sacral anesthetics we judge the size of the sacrum by the distance between the posterior superior spines of the ileum, together with the triangle formed by joining these with the sacral hiatus. This is inaccurate but serves as a practical guide. If we carefully follow the pulse, an estimate of the general absorption is possible. While injecting the nerves in the lateral sacral foraminae procaine solution is occasionally encountered having passed out from the sacral canal. There is no way of determining the permeability of the nerves except by the anesthetic effect obtained. It is our habit to test the operative field for anesthesia before the patient enters the operating room.

#### TYPES OF ANESTHESIA

Suprapubic cystotomies are performed under a field block anesthesia. We have recently been using an inverted v, transverse incision, to open the bladder, instead of a midline incision. This is done because it is unnecessary to open the space of Retzius, the vertex of the bladder is easily found by following the urachus, and the exposure of the interior of the bladder is much better. A wheel is made at the lateral border of the rectus muscle on each side, midway between the symphysis pubis and the umbilicus. Subcutaneous infiltrations are made from these wheels to the umbilicus and to the symphysis pubis. Directly under this subcutaneous infiltration the fascia covering the recti

muscles is punctured at intervals of 1 in., and 3 to 5 c.c. of procaine solution deposited in each place. It is possible to open the bladder satisfactorily with this anesthesia, but it permits only the most gentle manipulation within the bladder.

Sacral anesthesia is administered in the usual manner by injecting 30 to 40 c.c. of 1 per cent procaine solution slowly. After a wait from ten to twenty minutes, the perineum is tested for anesthesia. If anesthesia is not satisfactory, more procaine is added and the perineum again tested. This is repeated until satisfactory anesthesia is obtained. Usually 60 or 65 c.c. is the largest amount required although larger doses have been used. This anesthesia is satisfactory for cystoscopy or any operative procedure through the cystoscope, prostatic abscess, urethrotomy, periurethral abscess or other minor perineal operations.

Sacral anesthesia is also sufficient for most perineal prostatectomies but in order to obtain more uniform results, we augment this with transsacral nerve-block. The upper four sacral nerves are injected through the lateral sacral foraminae, according to Labat,<sup>11</sup> using 3 to 5 c.c. of procaine solution in each. The sacral needle is first inserted and 20 to 30 c.c. of 1 per cent procaine is injected slowly, allowing the needle to remain in position. The lateral sacral nerves are then injected and the perineum tested for anesthesia. If this is not sufficient more solution is slowly injected into the sacral canal, allowing time to elapse after each injection before the perineum is again tested for anesthesia. During more than two years we have had but one failure by using this method. No preliminary analgesia has been used.

Paravertebral anesthesia for kidney and ureter operations is administered according to the method devised by the author.<sup>9</sup> A preliminary analgesia of morphine has been given to most of our patients but we are attempting to find some drug to supplant this which will dull the perceptions and be perfectly harmless. This is particularly

important when one is dealing with urological patients who manifest varying degrees of renal damage. The anesthesia is satisfactory in from 85 to 90 per cent of cases. When it is not entirely successful, only a small amount of inhalation anesthesia is required, and we believe the patient has benefited by the necessity for using only this small amount.

Scrotal cases are anesthetized by blocking the ilioinguinal and iliohypogastric nerves just medially to the anterior superior spine of the ileum, and the genital branch of the genitocrural nerve in the spermatic cord. This is augmented by a subcutaneous infiltration around the base of the scrotum and along the line of incision. The operation for hydrocele or varicocele, and epididymotomy, epididymectomy or complete castration may be performed with this anesthesia.

Combined sacral and suprapubic field block anesthesia is necessary for operations for bladder stones, bladder tumors, resection of the bladder, suprapubic prostatectomy, diverticulum or any procedure requiring manipulation of the bladder. This combined anesthesia is successful in practically every case.

Circumcision or urethral repair is satisfactorily performed by a nerve-block anesthesia at the base of the penis.

#### TOXIC MANIFESTATIONS

So-called idiosyncracies to procaine are very rare, and we have experienced none. Fear combined with the prick of a needle may cause complete temporary collapse but the fear rather than the procaine is the cause of the shock.<sup>10</sup> If the apprehension in these patients can be eliminated, the usual procaine anesthesia can be administered without any reaction.

Toxic manifestations from procaine appear within fifteen minutes after subcutaneous injections. A slight feeling of dizziness and profuse perspiration are common. In occasional patients the pulse becomes shallow and the blood pressure is diminished temporarily. These symp-

toms are very transient and disappear rapidly. Caffeine or adrenalin hypodermically are sufficient for the relief of these intoxications.

There have been three severe toxic reactions from procaine occurring just after the administration of paravertebral anesthesia. Two patients manifested clonic contractions lasting about half a minute, resembling a petit mal epileptic seizure. The pulse became very shallow and they remained in a stuporous condition for about twenty minutes. A subcutaneous injection of adrenalin was given and the pulse returned to normal in five minutes. The operation was performed successfully and no after effects were noted. The third patient, who also had an enlarged thyroid, developed a peculiar intermittent twitching of her entire body although most apparent in her face and neck. During each spasm which lasted about ten seconds, her breathing ceased, but her pulse remained regular and of good quality. Between attacks, the breathing was regular and she appeared to be in a normal sleep. Adrenalin (10 min.) was given; this seemed to cause the attacks to be prolonged and more frequent. Codeine phosphate (2 grains) was given and the head of the table raised, because the twitching seemed to be caused by some cerebral irritation. Oxygen was also administered. The spasms soon ceased having lasted intermittently for about thirty minutes. The operation was postponed and there were no after effects. Dr. William R. Williams believed that hysteria and her goiter were important factors in this reaction. It is possible that some procaine solution might have been injected directly into the blood stream or into the spinal canal, but one would certainly not expect this reaction from such an accident.

#### CONCLUSIONS

1. Regional anesthesia using 1 per cent procaine solution is the safest form of anesthesia, especially for urological cases.
2. An ideal anesthetic combines relief of pain in the operative field with complete

mental relaxation. This can be accomplished with regional anesthesia and a satisfactory sedative.

3. The toxicity of procaine depends entirely on the strength of the solution and the rate of administration. Procaine is destroyed in the liver at the rate of one lethal dose every twenty minutes with no cumulative effect, and adds no additional burden on the kidneys.

4. The pain actually felt or experienced varies in different individuals undergoing the same procedure for the same ailment.

5. The amount of procaine solution necessary to produce anesthesia varies

with individuals. This is particularly true in sacral anesthesia because of variations in:

(a) Size of the sacral canal.

(b) Permeability of the nerves.

(c) Absorption.

(d) Extravasation of the solution through the lateral sacral foraminae.

(e) Threshold of pain.

6. Idiosyncracies to procaine are very uncommon. Toxic manifestations occur but are usually transient.

7. All urological operations may be successfully performed under regional anesthesia.

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# TUBERCULOUS SALPINGITIS

## REPORT OF CASE WITH UNUSUAL SYMPTOMS IN WHICH EXTREMELY LARGE INFLAMMATORY MASS SIMULATED AN OVARIAN CYST\*

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**T**UBERCULOUS disease of the fallopian tubes is by no means a rarity, while involvement of the ovaries is comparatively infrequent. The case here described merits recording because of the unusual size of the tumor masses and because it affords an opportunity to emphasize certain points concerning the diagnosis and treatment which will bear reiteration.

In spite of the fact that a voluminous literature on tuberculosis of the female genitalia had accumulated, the subject was accorded scant space in the earlier textbooks on gynecology. For this reason Charles C. Norris,<sup>1</sup> in 1921, published a comprehensive monograph, outlining the history, reviewing the literature and recording his experience with tuberculosis of the female generative organs.

In the same year Greenberg<sup>2</sup> presented a study of 100 cases of patients having tuberculous salpingitis operated upon at Johns Hopkins Hospital. In the following year Peterson<sup>3</sup> analyzed a series of 100 cases.

Since that time the subject has been quite thoroughly reviewed by a number of writers in connection with the report of cases that presented unusual features, and the recent textbooks outline the more generally accepted facts relative to the subject. For example, Graves<sup>4</sup> analyzes all the cases of genital tuberculosis treated at the Women's Free Hospital, Brookline, Mass., during a period of twenty-five years, and Anspach<sup>5</sup> gives a fairly adequate summary of the authoritative knowledge of the subject.

It is generally agreed that the most frequent site of tuberculosis of the female genitalia is the fallopian tube, which according to Anspach is involved in 90 per

cent, and according to McLean<sup>6</sup> in 80 per cent, of all genital tuberculosis. The next most frequent site is the fundus of the uterus. The ovaries are not often involved, and the cervix and vagina rarely. Both tubes are commonly affected, though in varying degree, and it is not an unusual occurrence to find that the disease in one tube can only be detected microscopically. According to Norris, tuberculous salpingitis constitutes from 4 to 12 per cent of all tubal infections; Whitridge Williams,<sup>7</sup> McLean,<sup>6</sup> Norris and Greenberg,<sup>2</sup> in their personal experience found the figure to be 7 per cent; while Graves places the incidence at 2.26 per cent of all tubal inflammations. Curtis<sup>8</sup> found 5 per cent of all tubes in 300 operations to be tuberculous and Wahl<sup>9</sup> found the same percentage. Ricard<sup>10</sup> in 325 operations found 8 cases of tuberculous adenitis, or 2.4 per cent. A tuberculous infection usually spreads rapidly to the fundus of the uterus. Statistics with reference to the frequency with which the ovaries are involved are, naturally, more meager in view of the fact that these organs are less frequently infected. Anspach estimates that tuberculosis of the ovary occurs in less than one-third of the cases of genital tuberculosis.

That tuberculosis of the fallopian tubes does not more often involve the ovaries has been found difficult to explain, for as Norris points out a tuberculous salpingitis results in the formation of considerable irritating secretion which is poured into the peritoneal cavity, as is evidenced by the many adhesions characteristic of this type of infection. Another factor which would seem to favor infection of the ovaries is that in tuberculous salpingitis the abdominal ostium has a marked tendency to remain patulous, thus offering a means

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of exit for the escape of the tubal contents, which drip down over the ovaries. The explanation offered is that the ovaries possess some inherent immunity to this form of infection. When infection of the ovarian stroma occurs, it is usually the result of infection gaining access through a ruptured follicle, the lesion often being an abscess of the corpus luteum.

It is the consensus of opinion that tuberculous infection of the generative organs is secondary to a focus elsewhere in the body, even though such focus may no longer be active. A number of cases are recorded, however, in which the evidence points to a primary infection. Possibly even in most of these cases, if a thorough post-mortem examination were made, a primary focus would be discovered.

As to the age incidence, no age is immune. Brunning,<sup>11</sup> as early as 1902, collected 46 cases of genital tuberculosis in the young. In Norris' 30 cases the ages varied from eighteen to forty-one years. Women past the menopause are rarely attacked by this form of tuberculosis. The age of highest incidence is between twenty-five and thirty years.

The incidence of menstrual disturbances in tuberculous salpingitis is placed by various authors at from 50 to 90 per cent.

The lesions produced by tuberculous genital infections are protean in form and extent and may involve any of the contiguous structures: the appendix, intestines, bladder or rectum. Furthermore, tuberculous infection may be associated with staphylococcal, streptococcal, gonococcal infections or with carcinoma.

#### PATHOLOGY

The lesions of tuberculosis of the tubes and ovaries are those typical of tuberculosis elsewhere: inflammation, necrosis and the characteristic tubercles. Condamin,<sup>12</sup> following the teaching of Villard, classifies tuberculosis of the adnexa into three groups, according to the stage of the disease:

1. Serous tuberculosis of the tubes.

2. Parenchymatous or interstitial tuberculosis.

3. Ulcero-caseous.

This he finds a fair guide to treatment, the serous type being amenable to medical and hygienic treatment; in the parenchymatous stage, conservative operative procedures may suffice; while in the ulcero-caseous, radical surgery is required.

In a very thorough histogenetic study of the tuberculous process in the adnexa, Horálek<sup>13</sup> endeavors to show that the changes are largely in the nature of a defense reaction to protect surrounding structures from invasion. He writes that in caseous destruction of the tubal mucosa, there is cholesterol formation, the tuberculous origin of which is evident by granulations. These change to hyaline connective tissue, which surrounds the cholesterol-like foci. At this stage the tuberculous area resembles a dermoid (pseudodermoid). Such areas are sometimes partially surrounded by a defense labyrinth and often by calcium incrustations. Large pseudodermoids may acquire serous contents as the result of loss of cholesterol and become cystic, a change which is especially apt to occur in caseous foci in the ovary. Another sign of regeneration is the formation of calcium deposits in the giant cells of the nodules. Calcium deposits, incrustations and foci of lymphatic infiltration are, according to Horálek, evidence of a tuberculous process. In the ovary there is small cystic degeneration due to adhesive inflammation or the effect of toxins. Tuberculosis is indicated by the presence of caseous foci and in the healing period by pseudodermoids, cysts with hyaline walls, and hyaline bodies in the wall which are stained with blood pigment. In post-tuberculous changes, dystopic inverting and papillary everting proliferation and numerous calcium deposits in the ovaries are striking. This picture, Horálek claims, is always indicative of tuberculosis whether or not the tubercle bacillus is present. In fact it is frequently impossible to find the microorganisms in the specimen.

In a recent pathological study of 78 cases of tuberculous salpingitis, Denton and Dalldorf<sup>14</sup> raise the question whether tuberculosis is not diagnosed too frequently on the finding of pinhead-size gray bodies and signs of irritation. They state that calcium, magnesium and phosphate are always present in the body fluids and, if the metabolic processes are deranged, they may be deposited in crystalline form and persist as foreign bodies which form lesions simulating those of tuberculosis. In a considerable percentage of their cases, they found that the tubes were not enlarged to the extent that might be expected in tuberculosis and the general health of the patients was good, and not indicative of tuberculosis. They leave the question open to further investigation but suggest that possibly the statistics as to the incidence of tubal tuberculosis may have been rated too high.

#### SYMPTOMS AND DIAGNOSIS

One of the chief points of interest in connection with pelvic tuberculosis is the difficulty of diagnosis, inasmuch as there is no characteristic train of symptoms to distinguish tuberculous from other forms of infection of the fallopian tubes. Norris tabulates 25 points on which he makes comparison between tuberculous gonococcal and streptococcal infections of the adnexa, but nevertheless acknowledges that the differentiation is very difficult. Nearly all writers make the statement that the diagnosis is not often made before the abdomen is opened.

The onset of the disease is usually insidious; its progress, slow. Generally there are a depressed state of health, loss of weight, anorexia, lumbar and lower abdominal pain and various menstrual disturbances. McLean says, other things being equal, if nodules can be felt in the fallopian tubes near the uterus or in the uterosacral ligaments, they may be regarded as very suggestive of the nature of the involvement. Clinically a presumptive diagnosis would be justified in a case

of bilateral enlargement of the tubes occurring in a virgin, in whom other forms of tubal infection could be excluded, especially if associated with the general symptoms enumerated previously. In many cases the temperature is not affected, while at times there is a slight rise of temperature in the evening. The difficulty of demonstrating the tubercle bacillus is generally admitted. Norris, however, claims that he has been able to demonstrate the microorganism in the leucorrheal discharge in 4 out of 11 cases, and other observers have reported good results by this method. Caution must be exercised, however, to eliminate the smegma bacillus, which may easily mislead the bacteriologist. Where there is any suspicion of the possibility of tuberculous infection, it is important that roentgenograms of the chest be made. It is also suggested that in selected cases it may be advisable to withdraw peritoneal fluid and make guinea-pig inoculations. This procedure is not, however, generally practical; but it may be resorted to where tuberculosis of the peritoneum is suspected, since in such cases it would not be justifiable to submit the patient to a radical operation.

In addition to the finding of tuberculous nodules in the fallopian tubes, several authors have called attention to a peculiar sensation of resistance in the tissues over the affected areas. Braude,<sup>15</sup> in particular, has emphasized this feature as distinctive of tuberculosis, and states that it can nearly always be elicited by bimanual and rectal examination. He attributes it to an effort on the part of the structures to protect the peritoneum. The importance of careful history taking cannot be too forcibly stressed, for in this way indications of an earlier infection of the lungs, the peritoneum, the glands or the bones will often be revealed.

Even conceding the difficulty of reaching a definite diagnosis as to the type of infection in salpingitis, the gynecologist should not lose sight of the possibility of tuberculosis, especially in girls and

young women. Then, if the disease is still in the early stages, there is a possibility that if its true nature be recognized it may

per cent of cures, and he states that complete cure should ultimately result in the remaining 10 cases.

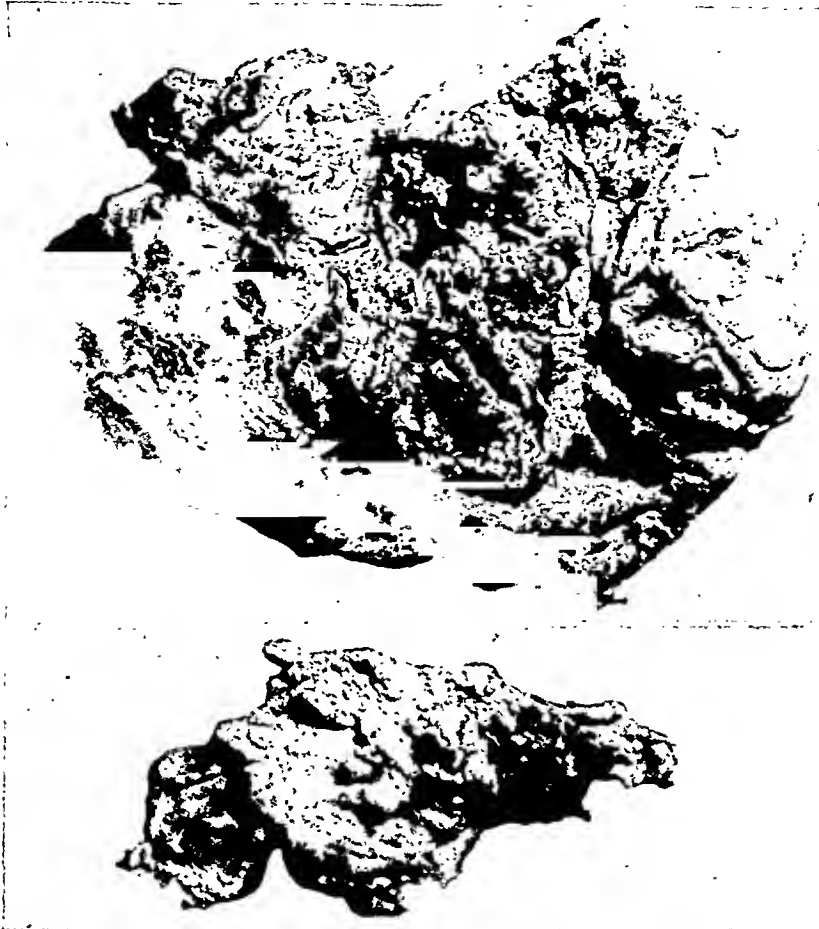


FIG. 1. Specimens removed at operation: upper, left tubo-ovarian mass; lower, the right.

be arrested by medical measures and recourse to surgery may be avoided.

#### OPERATIVE TREATMENT

In well developed cases of tuberculous adnexal disease it is generally conceded that total ablation offers the best chance of cure, as with removal of the tubes and ovaries the outlook is excellent, provided there is no active focus elsewhere in the body. Peterson believes that 75 per cent of patients operated upon should be alive and in good health for a considerable period of years. According to Wahl permanent cures are reported in 66 per cent of cases. Condamin's series of 53 cases showed 34 cures and 10 good results, or over 64

It is the consensus of opinion that hysterectomy is the operation of choice, leaving some ovarian tissue where the ovaries have not been involved. The extent of the operation must, however, be determined by the findings in the individual case. Some gynecologists refuse to operate in cases of tuberculous adenitis because of the difficulties offered by the many adhesions; but, if one is willing to exercise the patience and care required, the results obtained amply repay him for the undertaking.

#### CASE REPORT

F. G., aged twenty-seven years, unmarried, was admitted to the Lenox Hill Hospital on

February 8, 1930, with the diagnosis of left ovarian cyst. An appendectomy had been performed about eight years ago. Three months before admission she began to suffer from pain in the left inguinal region, and two weeks later there was pain higher up in the first quadrant of the abdomen. There was no fever and no discharge. Menstruation had been regular and of the four weeks' type. The patient had been treated medically by two gynecologists, but without improvement. At the time of admission she complained of constant pain in the lower abdomen, especially on the left side. She was rather thin and very pale.

Examination of the abdomen showed the walls to be thin. To the left of the uterus a tender mass could be palpated, the upper pole of which extended to about 3 in. above the symphysis, in close approximation to the uterus. Vaginal examination was not feasible because of an intact hymen and an extremely narrow vaginal opening. On rectal examination the mass at the left side of the uterus was found to be tender and cystic. The uterus was enlarged and hard. The right adnexa were also slightly enlarged. Operation was advised and accepted.

**Operation.** On February 8 operation was performed under gas-oxygen narcosis, the procedures consisting in extirpation of the adnexa on both sides, myometomy and ventral fixation. Upon opening the abdominal cavity, a tumor mass the size of a giant melon was revealed. The tumor was apparently cystic and inflammatory. It filled the cul-de-sac and was firmly embedded by manifold adhesions, which made it impossible to differentiate between the tube and the ovary. A similar condition was found on the right side, the mass consisting of the tube and ovary being the size of a small fist. In the anterior wall of the uterus was a round myoma deeply embedded in the musculature. In order to determine the contents of the left-sided tumor, a trocar was inserted, which gave exit to thick, slowly flowing pus. Suction was then employed and about 200 c.c. of thick pus was withdrawn. The tumor was then freed from the surrounding adhesions with great difficulty, as it extended down to the lowest part of the pelvis. The entire mass including the purulent ovary, which was oozing very thick pus, was at length removed. The stumps were ligated with double chromic catgut.

The right tube and ovary were then removed. They also were found to be exuding thick pus, and at one place on the right tube there was caseous material. The intramural myoma was then enucleated and the bed closed with two running chromic catgut sutures. As there was

some oozing in the cul-de-sac, packing was inserted through the abdominal incision.

The orientation in this case was extremely

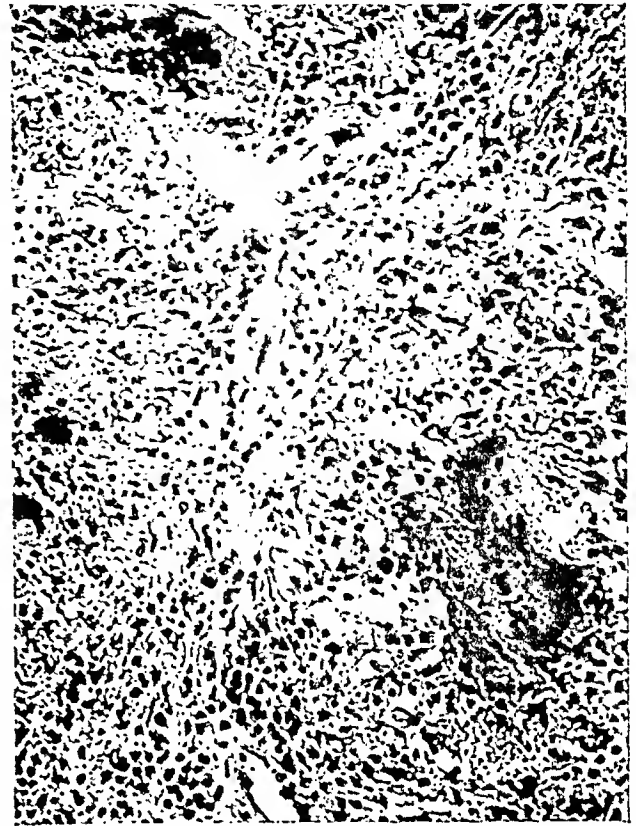


FIG. 2. Microscopical section through left fallopian tube.

difficult, due to the fact that the ovaries as well as the tubes were embedded together, so that there were two complete masses filled with pus. The nature of the pus and caseous matter in one of the tubes was suggestive of an old tuberculous process, although there were no signs of tuberculosis in the peritoneal covering of the tubes.

The second day after the operation the packing was removed from the cul-de-sac under ether narcosis. After removal of the drains, there was considerable purulent discharge from the wound, and ten days later the entire suture in the fascia had broken down. A profuse discharge of pus continued for about two weeks; but, under appropriate treatment, it gradually subsided and the wound slowly healed.

At different times during convalescence, specimens of pus were sent to the laboratory for examination, but always with negative results.

The patient was discharged on March 17, at which time rectal examination revealed perfectly normal conditions in the pelvis. The

wound was still open and discharging slightly. After leaving the hospital, the patient received six roentgen-ray treatments of the pelvis and abdomen. By March 30 her weight had increased to 108 lb.

*Pathological Examination.* The specimens, received in their fresh state, consisted of (1) the left ovary and tube, (2) the right ovary and tube and (3) a small fibroid.

The left tube and ovary consisted of a mass of beefy red tissue, necrotic in appearance and measuring 15 by 12 cm., about the size of a grapefruit. The mass, which had been opened, when folded together and reconstructed was seen to be cystic and had many adhesions. On the surface there were a few grayish tubercle-like nodules the size of a pinhead. The inner surface was red, convoluted, apparently necrotic, and one part resembled intestinal mucosa. There were numerous small grayish-white tubercles on the inner surface. At one edge there was firm white tissue resembling carcinoma. At the opposite edge was the remnant of the tube, which was small and completely enveloped by pinkish necrotic tissue. The adherent ovary measured 6 by 4 by 2 cm. and contained thick yellowish cheesy pus.

The right tube and ovary had also been cut open. When reconstructed it measured 10 by 5 cm. The outer surface showed adhesions. The inner surface was, for the most part, covered by cream-colored cheesy material, which appeared to be necrotic. The attached ovary was also filled with similar thick cheesy substance.

The third specimen was a small nodular fibroid about 3.5 cm. in diameter which, on section, showed tough white fibrous tissue arranged in whorls.

*Microscopically,* sections of the left tube showed the mucous membrane to have been destroyed and replaced by tuberculous granulation tissue. There were numerous areas of caseation and suppuration. A few tubercles were noted in the muscularis, which was greatly thickened by fibrosis. The corresponding ovary was largely transformed into fibrocaseous tuberculous tissue.

Sections of the right tube showed lesions similar to those of the specimen from the left side. In places there still persisted mucous membrane, the folds of which were extensively fused together. In the mass was a large cavity filled with cheesy material and surrounded by a capsule of fibrous tissue, the greater part of which had undergone hyaline degeneration. Discrete tubercles were not detected in this organ.

The uterine tumor on section was found to be an ordinary fibroma, in which smooth muscle

and fibrous tissue were present in about equal proportions. This growth also showed hyaline degeneration.

#### COMMENT

In some respects this case is quite typical of tuberculous involvement of the tubes and ovaries, while in others it is somewhat unusual. The onset was evidently slow and insidious, as is usual with the chronic form of the disease. The case illustrates very decidedly the difficulty in making the diagnosis, for the patient had been treated by two gynecologists without suspicion as to the nature of the infection having been aroused. When she came under our observation, the condition was such that only surgery could offer any hope of relief, whatever might be the cause, so extensive investigation as to the character of the lesion was unnecessary. The case was typical as regards the age incidence and the bilateral involvement. Postoperative complications similar to those occurring in this case are rather characteristic of tuberculous infection of the genital organs. Many authors call attention to the tendency to fistula formation, discharge and slow healing. The frequency of postoperative complications as well as the difficulty encountered in operation because of the adhesions has frequently deterred surgeons from attempting a radical procedure. That the tubercle bacilli were not found in the discharges from the wound is not surprising, as it is frequently impossible to find them either before or after operation.

The case was unusual in respect to the paucity of symptoms in view of the extensive and advanced stage of the lesions. The patient had had no evening temperature so far as could be ascertained. Menstruation had been regular, whereas in a large percentage of these cases, especially when the process is well developed, one may expect to find menstrual disturbances. There was no discharge, a sign which is fairly frequent. It is rather remarkable that with the extensive suppurating involvement the peritoneum should ap-

parently have escaped infection. It affords a good example of the effectiveness of the defense processes in some of these cases.

The most interesting feature is the immense size attained by the tumor mass. Gynecologists agree that tuberculous tubes and ovaries may attain enormous proportions, and a number of illustrative cases are reported in the literature. McLean describes a case in which the specimen from the right side measured  $6 \times 4 \times 4$  in., while that from the right side was somewhat smaller; in a second case which he cites one tube measured  $9\frac{1}{2} \times 4 \times 2$  in. He says the tubes may even rise above the umbilicus if they are sufficiently free from adhesions. In the Cabot Case Reports<sup>16</sup> an instance is recorded in which the dimensions of the specimen were  $8 \times 5 \times 4$  cm.

#### CONCLUSIONS

##### 1. Tuberculosis of the fallopian tubes

is not a rare condition, but involvement of the ovaries in the disease process is of relatively infrequent occurrence.

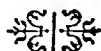
2. Practically all cases of tuberculosis of the tubes and ovaries are secondary to foci of infection in other parts of the body.

3. Differential diagnosis of tuberculosis salpingitis in its early stages from other infections of the fallopian tubes is highly important. The gynecologist should bear in mind the possibility of this type of infection and should endeavor to detect it by taking a careful history, by examination of the vaginal discharge, by x-ray examination of the chest and by guinea-pig inoculation in selected cases.

4. In the later stages of tubal and ovarian tuberculosis, radical surgery offers the best prospect of cure (66 per cent of the cases), provided the primary focus is not too far advanced to justify surgical intervention.

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# PREGNANCY WITH BILATERAL OVARIAN CYSTS

## BILATERAL OOPHORECTOMY FOLLOWED BY NORMAL CHILDBIRTH\*

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PREGNANCY in the presence of ovarian tumor has always offered a debatable problem. The older writers were reluctant to interfere, owing to the fact that they feared excessive hemorrhage, as it was formerly supposed that pregnancy always produced an increased arterial tension and a hydremic condition of the blood. The early cases operated upon were performed in ignorance of the existing pregnant condition and were invariably followed by abortion.

In 1846 Bind operated upon a woman for an ovarian tumor and found that she was three months pregnant. Abortion followed but the patient recovered. Sims, however, removed an ovarian tumor from one of his patients and also discovered that the uterus was the size of a three months' pregnancy, but to his surprise the pregnancy continued to term with the birth of a living child. This was the first instance in which pregnancy culminated normally following such procedure.

Since then there has been abundance of evidence both from the experimental laboratory and operating room to prove that pregnancy may continue to term in spite of the removal of the ovaries and corpora lutea.

Waldstein<sup>1</sup> recently performed a bilateral oophorectomy in a woman who was two months pregnant, the pregnancy being complicated by bilateral dermoid cysts. A normal termination of birth resulted, the child weighing 3500 gm. The ovarian hormone content of the blood serum of this patient was studied and found to be like that of normal women. From further study of the placenta, Waldstein determined that hormones do not originate in the ovary, but rather in the placenta. The hormone produced from the placenta was given into the blood "in

status nascendi," for as much ovarian hormone could be found in the blood of the placenta as occurs in the placenta itself. It was conceived therefore that the placenta produced active substances which were none other than hormones.

Graefe<sup>2</sup> states that ovarian tumors produce abortions or premature labor in as many as 14 to 20 per cent of such cases. Renny who studied a series of 321 cases of pregnancy with this complication, concluded that 17 per cent of them eventually aborted. The latter is brought about either by incarceration of the tumor or uterus within the pelvis, by twists of the pedicle, adhesions, pressure from tumor masses or by infection.

According to the experience of McKerron<sup>3</sup> 25 per cent of all ovarian tumors occurring in pregnancy lie in the pelvis and are not discovered until the onset of labor. It is at once apparent, from the aforementioned facts, what may be expected in such cases during labor. Heiberg<sup>4</sup> reports that in only 18 out of 52 cases of pregnancy complicated by ovarian tumor was the latter diagnosis made before the abdomen was opened.

Given a diagnosis of ovarian tumor associated with pregnancy, the question arises as to the advisability of operation, and if agreed upon, the time of operation. According to Frank<sup>5</sup> it is thought best to postpone operative interference for at least four to six weeks after the beginning of gestation, for during the first few weeks of pregnancy the life and growth of the ovum depend upon the presence of the corpus luteum. Removal of an ovarian tumor together with the corpus luteum at this time would undoubtedly terminate in abortion. After the first few weeks of nidation, however, the placenta assumes the function of the corpus luteum, and

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at such times operation may be undertaken with the hope that it will not interfere with the existing pregnancy.

Pinard and also Szymkowitz state, "that all ovarian tumors diagnosed during pregnancy should be operated upon." The latter adds the words "at once"; but in the face of what has been mentioned, that seems too radical a procedure to follow.

The paramount question at issue, then, is the factor of time in the removal of the ovarian tumor. Many writers agree that if oophorectomy is performed interruption of pregnancy results more frequently during the second half than during the first half of gestation. Tumors discovered during the second half of pregnancy should be left alone unless definite indications for operative interference arise. McKerron on the other hand believes in early operation, but DeLee<sup>6</sup> with a more conservative attitude believes that one must individualize one's cases. Aged primipara or a woman with a double ovarian tumor wishing a child should not be subjected to operation. A small tumor, freely movable, high in the abdomen may be left undisturbed with impunity both to mother and child. Rupture of an ovarian cyst which may cause subsequent alarming symptoms of peritoneal irritation may necessitate immediate operation even at a time when it would be preferable to postpone the operation for a more favorable period.

Pucel reported that 16.5 per cent of his operative cases were followed either by abortion or premature labor, while Heils<sup>7</sup> reports as many as 19.47 per cent of his operative cases doing likewise. It has been previously mentioned that this accident occurred in 17 per cent of Remy's<sup>8</sup> collected cases without any operative interference whatever.

Owing to the constancy of outcome with and without operative intervention and to the rarity of the condition under discussion the following case is of extreme interest and therefore reported:

#### CASE REPORT

A. S. White female, thirty-four years of age, married eleven years. Her father died at the age of fifty-four from carcinoma of the lungs; her mother sixty-nine years of age, is living and suffering from diabetes. Her family history is otherwise negative.

*Past personal history:* At the age of three years the patient had diphtheria and at six years scarlatina. There were two full-time stillbirths, nine and seven years ago respectively. One living child was born five years ago. All deliveries were normal. The date of last menstruation was May 19, 1929.

*Chief complaint and history of present illness:* On September 12, 1929 when patient was first seen she complained of severe pain in the abdomen. This pain was limited to the area below the umbilicus and in the region of both groins. It was colicky in nature and was apparently stationary except for occasional reference to the back. This pain began about two weeks prior to September 12, but was not as severe and intense as on the day when patient was first seen. There was a complaint of polyuria for the past few weeks, but no urgency associated with it.

*Physical examination:* A young woman, well nourished, lying in bed on her left side, with knees drawn and apparently in great distress, suffering from pain. Her face was flushed, pulse rapid, 110 to the minute and of fair quality. The temperature was 102 F. Her blood pressure was 140 systolic over 80 diastolic. Examination of the head, neck and thorax revealed nothing abnormal, except hypertrophied tonsils. Examination of the abdomen revealed a fullness in the lower half, greater on the left than on the right. There was extreme tenderness on palpation over the entire abdomen with increased muscle spasm throughout. A mass was felt in both the left and right lower quadrants, and each was definitely isolated from the uterus. The left mass extended about 3 in. above the level of the umbilicus. A pelvic examination revealed an enlarged, soft uterus and cervix and two distinct masses discernible as separate and distinct from that of the uterine enlargement. The mass on the left as already described, was about the size of an adult head; that on the right the size of a grape fruit. Twenty-four hours later all signs and symptoms were exaggerated. The temperature rose, the abdominal



muscle spasm increased, the pain grew more intense, the pulse more rapid and thready.

A blood count showed an hemoglobin of 80 per cent, an erythrocyte count of 5,140,000, a leucocyte count of 19,400, with 81 per cent polymorphonuclear cells, 11 per cent small lymphocytes, 5 per cent large lymphocytes, and transitional cells 3 per cent.

A non-catheterized specimen of urine at that time showed a specific gravity of 1.025, was cloudy in appearance and yielded a heavy ring of albumin to nitric acid and a heavy precipitate to the heat test. Microscopically the urine showed an abundance of pus cells and a few red blood cells. There were no casts.

In view of the history of amenorrhea since May 19, 1929, and the presence of distinct masses separated from an enlarged, soft uterus, a diagnosis of bilateral ovarian cysts and pregnancy was made. The presence of fever, rapid pulse, leucocytosis and symptoms of peritoneal irritation were indicative of either a twisted pedicle or a rupture of the cysts into the abdominal cavity.

In the presence of such indications necessitating immediate operation laparotomy under neocaine spinal anesthesia was performed and the following were the findings:

Bilateral ovarian cysts, the left the size of a large melon, the right the size of a grapefruit. Both were ruptured with twisted pedicles and free fluid in the peritoneal cavity. The uterus was enlarged, soft and about four months pregnant. A bilateral oophorectomy was performed, the position of the uterus being as little as possible disturbed.

*Pathologist's report:* The specimen consists of two tumor masses, one measuring 12 cm. in diameter and the other 16 × 12 cm. The masses present an uneven nodular external surface and a polycystic cut surface. The individual cysts range from 3 to 6½ cm. in diameter and are separated from each other by thin septa. Some cysts contain yellowish fluid, others gelatinous masses. The cysts are for the most part situated on the periphery. The central area of the cut surface consists of edematous connective tissue. The parenchyma is greatly atrophic.

*Diagnosis:* Cystoma ovarii duplex.

*Subsequent course:* The patient made an uneventful recovery and was discharged from

the hospital October 1, 1929. On March 11, 1930 she was delivered of a full-term living normal male child. Delivery was not instrumental and labor was of normal duration. Convalescence was uneventful and the patient was again discharged from the hospital on March 22, 1930.

#### COMMENT

Although one cannot draw conclusions from the data obtained from 1 case, a careful perusal of the literature leads one to believe that these results coincide with the general consensus of opinion. The patient was operated upon owing to the fact that signs, symptoms and laboratory data pointed towards some intra-abdominal catastrophe. Two ruptured ovarian cysts, both with twisted pedicles and free fluid in the abdominal cavity were found. According to the menstrual history obtained the patient was four months pregnant and therefore fell into the category of those patients operated upon during the first half of pregnancy. This period is considered the safest period during which one can, with a fair degree of safety, remove the ovaries and their corpora lutea without disturbance of the existing pregnancy. The case under discussion amply illustrates this fact by its subsequent course and events. It also proves the contention of Frank and others that pregnancy can go normally to term in the absence of the ovaries and their corpora lutea.

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# OPERATIVE ARTHRODESIS OF THE SPINE

## A CONSIDERATION OF THE EMBRYOLOGICAL AND MECHANICAL FACTORS INVOLVED\*

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IT has been known for many years that fusion of the posterior portion of the spine often precedes ankylosis of the vertebral bodies. Hadra in 1891<sup>1</sup> wired the spinous processes to achieve this result. Lange<sup>2</sup> placed metal rods and later celluloid splints below the muscles on either side of the spinous process to hasten ankylosis. It is of interest to note that he also suggested transplantation of bone for the same purpose. Calot in 1897<sup>3</sup> introduced a technic which closely simulated that of the fusion operation.

The two methods most commonly used now are the extra-articular arthrodesis with inlay tibial graft first described by Albee and the intra-articular fusion of Hibbs. The former operation obtains splintage of the spinous processes by the tibial graft. The corrective effect is obtained by the use of the spinous process as a lever; the articular process as the fulcrum, the resultant tension being applied to the involved vertebral bodies.

In the fusion operation, the periosteum is removed from the spinous processes and laminae in addition to the articular processes being curetted and the spinal ones being broken down. This intricate technic is designed to obtain a suitable medium for bony union of the lamina and spinous processes, but relies entirely on spinal bone for this objective. There are many variations of these two methods, and certain operations combine features of both.

A brief elucidation of spinal mechanics may aid in obtaining a clear comprehension of the principles on which this process is predicated. The spinal column besides affording protection for the cord is the semi-rigid framework for the locomotor

apparatus to which the arms, legs and head are appended.

Incidental to the evolution of the human biped from the quadruped, the postural weight of the body has been transferred exclusively to the lower limbs, thus placing a greater stress on the lower spine and pelvis. It is not surprising, therefore, to find that the majority of postural defects in man occur in this region of the spine and in the lower extremities. The frequent vertebral variations disclosed by x-ray and post-mortem examination, may be incidental to this evolutionary change.

Embryological study of the posterior portion of the spine has shown that in contrast to the peripheral osseous system, the development is primarily from ectoderm. In tracing this development, Willis<sup>4</sup> postulates as follows:

The posterior arch of the vertebra is formed ultimately from a folding over and midline fusion of ectoderm. At birth each lateral half of a neural arch consists of a flat bony plate united in cartilage by an inverted L-head with the body of the vertebra. The articular processes are not yet distinct, the plates simply overlapping slightly those of the adjacent segments. As the plates develop their inferior medial angles unite and from the site of union there grows the spinous process. From the superior and inferior lateral angles there develop the respective articular processes.

Our knowledge of osseous repair is based primarily on the phenomena observed in mesodermic bone present in the limbs, and as yet, we have no precise knowledge of nature's method of repair of bone of ectodermic origin.

Histological examination of living tissue from this region is difficult to obtain and

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information obtained from fluoroscopic or x-ray examination is meager; hence, post-mortem examination of spines which have been injured or diseased prior to death affords a most precise opportunity for observation of nature's spinal osteogenetic repair phenomena.

Willis,<sup>4</sup> in his study of 14,071 spines post mortem, found that there was separation of the neural arch in 3.8 per cent of the specimens studied. "Consideration of the individual specimens shows no callus formation or rounding off to the fragments suggesting fracture without union."

This agrees with the majority of clinical observations which show that fracture of any region of the spine, even the transverse process, is prone to poor osteogenetic repair. Nature's restriction of the growth of callus formation in this region of the body may be merely her method of obviating pressure on the spinal cord which would ensue if repair by callus formation were followed here to the same extent as is observed elsewhere in the body. These observations show that the reparative process, particularly of the posterior region of the spine, differs essentially from other regions of the body and is prone to delay if spinal bone alone is involved.

In osseous structures, mechanical efficiency is obtained by specialization of tissue. A characteristic of such specialized tissue is that the higher the degree of specialization, the poorer its physiological repair factor. Lerich enunciates this theory, which he and others support with a mass of observed data, and it is in strict accord with the biological laws. It has been found to apply most accurately, for example, in the study of the repair of nerve tissue. This rule particularly applies to the posterior portion of the spine where a high degree of mechanical efficiency is requisite, and hence, poor physiological repair might be expected.

To obtain the maximum benefit from either of these operations, it is of paramount importance that the embryological and mechanical characteristics of the

tissue concerned be correctly comprehended and appreciated.

The objective of the technique used in the fusion operation is to prepare a suitable environment for osteogenetic union of the posterior portion of the vertebra. This preparation, previously described, would be expected to stimulate osteogenetic repair by firm union. Using spinal bone alone in this region of the body would seem to be contraindicated by the factors detailed previously. Theoretically, the best results of this procedure should be obtained in younger subjects particularly in infants, where coarse fibered or primary bone exists and where specialization for weight bearing is as yet incomplete.

The commission appointed to investigate the result of ankylosing operations of the spine<sup>5</sup> report that the fusion operation has had little effect on the production of ankylosis in the body of the vertebra. Of the cases examined, only 18 showed ankylosis of the vertebra, and these were cases in which four or five years had elapsed since the observations made by the first x-rays. These cases were all in the younger subjects and no instance of fusion was seen in the adults. In a later report from the Orthopedic Hospital, one case of bony union was obtained in a child eighteen months old.

Observations previously made thus coincide with the clinical phenomena observed. It is of particular interest to note the great length of time required for ankylosis even in the younger subjects.

In the application of these principles to the inlay graft operation, mesodermic bone is inserted. This bone tends to keep its original characteristics. As it has a higher percentage of cancellous tissue, it also tends to promote an increased blood supply, particularly as the technic of its insertion brings it in close relation to the cancellous tissue of the spinal bone. Moreover, mechanically, the internal bone splint utilizes the entire length of the spinous process and attains an efficient leverage action which is more effective

than in the technic in which the spinous processes themselves are broken down.

In the report of the same commission, applying to the inlay graft operation, we find that, "In a great majority of cases, 80 per cent, ankylosis of the area was found to be present, the percentage varying directly with the age of the patient."

These findings are the exact opposite in the fusion operations as all the favorable results in the previous series occurred in the younger subjects.

The observation of other writers are of interest.

Ely,<sup>6</sup> who has had extensive experience with both types of operations, uses the inlay graft for cases with lumbar disease. Todd,<sup>7</sup> in reporting the dissection of a spine on which an Albee operation had been done found that there had been proliferation of new bone at the point where the graft was inserted into the spinous process precisely as in the repair of a fracture.

On the Second Division of the Hospital for the Ruptured and Crippled where both methods have been used for many years, it is the consensus of opinion that the fusion operation has given its best results in children and particularly in the cervical and dorsal regions of the spine. Its use in the lumbosacral region, particu-

larly in adults, has been almost abandoned, and the inlay graft used in such cases.

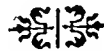
#### COMMENT

Knowledge of the embryology and physiology of the spinal column is comparatively meager so that the author desires to emphasize that the concepts enunciated in this paper are largely theoretical; however, it is gratifying to note that the clinical phenomena observed would seem to be explained by these observations and they are also in accord with the pathological findings as well as the theories of other workers.

It is hoped that the data presented will act as a stimulant to further research work in this important field and it may be of assistance in aiding the surgeon in the selection of the type of operation if arthrodesis of the spine is desired.

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# HEMORRHOIDS

## OBSERVATIONS ON THEIR TREATMENT WITH RECOMMENDATION OF AN IMPROVED OPERATION\*

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THE general practitioner is confronted with few conditions that will cause more acute suffering or that may be the basis of a greater variety of reflex disturbances than hemorrhoids. I am of the opinion that the general practitioner, as a rule, pays too little attention to the part played by chronic inflammation in and about the rectum as a causative factor in the production of various reflex symptoms manifested in the genitourinary, digestive or nervous systems.

Very true, hemorrhoids in themselves seldom cause death, but in this day of modern medicine and surgery life and death are not the only possibilities that we must consider in carrying out our treatment of a given case.

I can well remember when the surgeon felt quite a degree of pride in his work if his patient was able to withstand the ordeal of anesthetic and major operation and leave the operating room alive. He rubbed his hands together with a feeling of much satisfaction if after three or four weeks in the hospital the patient was able to be taken home alive but with various degrees of disability.

This has now all been changed. Modern efficiency in hospital service combined with more effective surgery has not only lowered the mortality rate and shortened the necessary period of hospitalization but it has made possible more perfect end-results.

The modern surgeon does not feel that he has fully discharged his whole duty when he has simply saved a patient's life by some cleverly performed operation.

Our duty as surgeons has not been fulfilled until our patient has been restored to the community with the minimum of disability, restored as a useful and efficient member of the commonwealth.

Investigation would show that there are thousands of both men and women whose efficiency is greatly impaired by the possession of chronic hemorrhoids: men who, instead of being able to do a full day's work with comfort, can work only a fraction of the time, and women whose household and social duties become drudgery because of the constant reflex disturbances due to the piles. In the former I have seen symptoms that have been considered of prostatic origin clear up perfectly after a hemorrhoid operation. In the latter, symptoms arising from hemorrhoids are often interpreted as of pelvic origin and local vaginal treatments, copious douching, or even some surgical procedure on the pelvic organs may be instituted in a futile attempt at their relief.

The anal canal extends from the levator ani muscle to the skin and is lined in its lower half with squamous epithelium. It is guarded by the internal and external sphincter muscles. The mucous membrane of the lower portion of the canal is thrown into a number of folds called the columns of Morgagni which contain on their interior some muscular fibers, a vein, and an artery. These veins frequently present varicosities in their lower portion and it is in this area that hemorrhoids have their origin. Between these columns are folds of mucous membrane known as the valves of Morgagni, and the pockets formed by these valves are often the seat of inflammatory conditions which frequently end in the formation of an ulcer, abscess or fistula.

The venous radicals, where these varicosities originate, connect directly with the superior hemorrhoidal vein. This vein is a radical of the portal system and has no valves, which accounts for the tendency to engorgement and formation of the varicose

\* Submitted for publication April 2, 1930.

condition which results in internal hemorrhoids. The direct connection of the anal region with the portal system communicates to any infection of this region the most serious possibilities.

Frequently varicosities of the inferior hemorrhoidal veins form below the mucocutaneous border under the skin of the anus resulting in what is termed external hemorrhoids.

If one examines carefully a cross section of an internal pile tumor one will find that it is composed of dilated blood vessels with a variable amount of connective tissue around and between them, and the whole mass covered by mucous membrane. An external hemorrhoid has the same general structures except that it is covered by skin. In addition to dilated veins each hemorrhoidal tumor is supplied with one or two arteries, branches of the superior hemorrhoidal artery. In large tumors with a single artery this vessel may be nearly as large as the radical artery at the wrist.

In studying the nerve supply of the anus we find a ready explanation for the various reflex disturbances that we have mentioned, for while the movable rectum derives its nerve supply from the sympathetic system, through the plexuses of Auerbach and Meissner, and is scantily supplied with sensory nerves, the anal canal derives its nerve supply from the spinal cord and because of its abundant supply of nerve filaments, is one of the most sensitive regions of the body; its nerves are in close relation to the origin of nerves which are distributed to remote parts.

The palliative treatment of acute piles is justifiable, but where the disease process has resulted in organized tumor formation, neither salves nor constitutional treatment will be of permanent benefit, and some one of the radical operations should be advised.

One of the oldest methods of treatment was by the injection into the pile tumor of various and sundry irritants or coagulants.

This method passed out of general use, as far as the modern surgeon is concerned, because surgeons learned that the pro-

duction of a thrombus in a varicose vein may easily lead to grave consequences. There are some, however, who still practice injection usually because their patients think that by submitting to injection they are sidestepping the dangers of an operation.

Such is not the case, however. Dr. Vernon David in Nelson's "Loose Leaf Surgery" after discussing injection says,<sup>1</sup> "Operative treatment is the safest procedure and gives permanent results if thoroughly carried out."

Cooke, in his very excellent work on "Diseases of the Rectum and Anus," speaks of the injection method in no uncertain terms.<sup>2</sup>

After viewing the matter impartially from every standpoint, the conclusion seems warranted that it is at best an unscientific and unsurgical makeshift which has been too long exploited at the expense of a credulous public—that it is not without danger in any case and permits no honest assurance to a patient of permanency of cure, should real danger be escaped. If the treatment is carried out after a full explanation on all points, the responsibility may in a sense be shifted to the patient. But while he may possibly soothe his conscience in this way, the surgeon certainly does not uphold the highest ideals of his profession.

At least as far back as 1813 the ligature method was practiced and for a short time was very popular in France, but because of bad results fell into disrepute. It still has a number of ardent supporters in America, whose chief argument in its favor is its simplicity. To say the least, the ligature method in its various modifications possesses certain objectionable features which are not in line with modern surgical teaching.

In spite of postoperative pain and frequent hemorrhage, the clamp and cautery method is perhaps the most universally used today. It has some good features; but if one has ever had a severe secondary hemorrhage following its use, one will hardly care again to trust the sealing of vessels, which may be as large as the

radial artery, to a mere crushing and searing process. Then too if you have an internal-external hemorrhoid to deal with you must use the clamp and cautery for the internal and suture for the external, as the burn of the skin may make a painful sore.

The Whitehead operation in spite of the many objections offered to it, is still done by some and in a limited number of properly selected cases is a most excellent procedure.

The clamp and suture method, in which the base of the pile is clamped, its top cut off outside the clamp, and then a continuous catgut suture introduced over the blades of the clamp, is becoming more popular every day and usually gives very gratifying results. Cooke says:<sup>2</sup>

My personal experience with this method has been highly satisfactory. Considered in comparison with the other methods in common use, it conforms more nearly to the recognized principles of surgical technic than any other with the exception of the clamp and cautery. That it has the advantage of greater security than the latter seems clear; and its relative simplicity is an additional weighty consideration in its favor. As between the two, the clamp and suture method seems on the whole the more nearly ideal.

Many other rectal specialists and general surgeons agree with Cooke in giving the clamp and suture method the highest place among the various operations that have yet been advised for the radical cure of hemorrhoids.

The clamp and suture operation as it is generally performed today, while more nearly approaching the ideal than any other is, however, open to one very serious objection in that the needle and suture, in passing through behind the clamp in this very vascular area, may carry infection into the hemorrhoidal veins which may give rise to either local or remote abscess formation. The late Dr. John B. Murphy, commenting on an improved suture operation which the author had suggested, was very emphatic in his condemnation of the old suture method. He said:<sup>3</sup> "Transfix-

ation of a vein with a suture in a zone grossly subjected to infection, as the anus, should not be done—the day of disaster is sure to come. An ascending infection through the middle and superior hemorrhoidal veins into the inferior mesenteric produces the fatal pyelphlebitis."

To approach the ideal an operation for hemorrhoids should be free from danger of infection of the hemorrhoidal veins, free from danger of hemorrhage, free from post-operative pain, should approximate the mucosa so as to leave no scar tissue, and should not traumatize the tissues enough to cause stricture. Not one of the old operations meets all of these conditions.

In 1916<sup>1</sup> I described an operation which to my mind and in my experience more fully meets all of the requirements of an ideal operation for this condition than anything yet published. Its safety and simplicity cannot help but appeal to every careful thinker and its efficiency can be most readily demonstrated by trial. The many favorable comments received and the fact that an improved clamp has just been put on the market by one of our well-known instrument manufacturers leads me to again present this operation for your consideration.

We may use either local, general or sacral anesthesia for this operation. In aggravated cases of long standing I prefer general or sacral anesthesia as it makes it easier to secure more complete dilatation of the rectal sphincters.

Two hours prior to the time of operation have cleansing enemas administered until the rectum is entirely emptied and seems clean.

Place the patient on the operating table in the lithotomy position; select a large, self-retaining, bivalve rectal speculum; lubricate well and insert it into the rectum with gentle pressure so as to avoid as far as possible trauma to the mucosa.

Now slowly and gradually dilate the sphincters using due care not to break muscle fibers or abrade the mucosa. By using proper caution and taking time the



sphincters may be so thoroughly dilated as to temporarily paralyze them and yet no permanent harm result.

In many cases of long-standing rectal irritation where the sphincters have become habitually tight this preliminary dilatation is in my opinion of distinct therapeutic value. Furthermore it is conducive to postoperative comfort.

After the rectum has been well dilated paint the mucosa of the rectal canal for 4 in. above the anus and the skin about the anus and over the buttocks with 3 per cent tincture of iodine.

Now with the bivalve speculum in place and the handles dependent, separate the blades. Usually a hemorrhoidal mass will appear between the blades protruding from the anterior wall of the rectum.

This anterior hemorrhoidal mass when present frequently gives rise to more symptoms than lateral masses and should be dealt with carefully and thoroughly to prevent skin tags that are conducive to pruritus.

Grasp the most dependent point of the tumor with the tip of a Rochester-Carmalt forceps; put it on tension if the tumor is large, while another hemostat picking up the overlying mucosa higher up in the rectum will facilitate the placing of the fenestrated clamp.

Now place the special fenestrated clamp over the tumor mass clamping its base firmly in line with the long axis of the bowel. Cut away all tissue distal to the clamp and we are now ready for stitching.

In most of the cases encountered the speculum can be removed as soon as the clamp is applied; then the tip of the clamp is brought outside the anal opening, which simplifies the stitching.

In a very few cases where the pile tumor arises high in the rectum and the tissues are in such a condition as to make it inadvisable to drag on the tumor the speculum may be left in situ and the stitching easily done from above downward within the rectal canal.

The stitching is very simple but should

be carefully done. Short, slightly curved, round pointed needles are threaded on each end of a No. 2 iodized catgut 20 in. long.

The first needle should enter the fenestra of the clamp near its tip, piercing mucosa and submucosa at the base of the tumor held within the clamp. Care should be taken not to place this first suture too deeply or there may be some vessels entering the tumor above it that might give rise to troublesome bleeding.

After the first stitch has been placed draw the suture through so that you have 10 in. protruding on either side of the clamp with a needle on each end.

Entering one needle from one side and the other from the other side continue a back and forth cobbler's stitch through the fenestrum of the clamp to the distal point on the tumor base.

Now remove the clamp and tie the suture firmly. Hemostasis should be complete.

While the immediate appearance might lead one to think that healing would leave a scar mass at the site of each hemorrhoid, such has not been our experience. In fact the scar left is very slight. It is in the line of the long axis of the bowel and has never, in our experience, given rise to symptoms of any sort.

During the stitching the special fenestrated clamp has effectively sealed the veins and prevented them from carrying infection from the suture line into the portal or the general circulation where disaster could easily result.

The pressure of this clamp while effective in sealing the vessels does not produce enough trauma to cause sloughing and the healing is very prompt.

After the hemorrhoidal tumor in the 12 o'clock position has been removed the rectum should be carefully inspected and where multiple pile tumors are present two or three more of the largest ones should be dealt with in the same general manner as the first.

I have found that it is rarely ever neces-



sary to remove more than four hemorrhoidal masses. While I have never seen this particular operation result in undue stricture of the rectum, I can vision the possibility if too much tissue is removed.

In the great majority of cases the thorough removal of these masses, one at 12 o'clock, one at 8 o'clock and one at 4 o'clock, will give the desired end-results.

When more than three tumors must be removed it is better to avoid the 6 o'clock position when possible.

In the foregoing we have been considering only internal hemorrhoids. I have found, however, that where the tumor is partly external extending under the skin of the anus, that I can so place my clamp as to include both skin and mucosa and proceed about as with internal tumors. Care must be exercised not to include too much skin in the clamp and not to crush it too severely. Excellent results may thus be secured.

Of course the acutely inflamed thrombosed external pile is best dealt with by incision and evacuation, due care being taken to favor prompt healing and thus prevent fissure.

In dressing my hemorrhoid cases following operation I use a small catheter wrapped with a few turns of gauze and heavily smeared with sterile petrolatum. This lies in the rectum without producing irritation and provides for the free escape of flatus which is very conducive to comfort. It may be withdrawn after thirty-six hours.

Following this operation patients could, if they so desired, be up and about immediately without fear of hemorrhage. Our method of postoperative care, however, includes a light diet for three days, mineral oil emulsion night and morning after third day, oil enema on fourth day. Morphine is used but few complain of pain.

In cases where the skin of the anus has

been included in the clamp or stitches we paint the exposed stitches twice daily with tincture benzoin compound.

In my first operations, looking to avoid the ever-present danger in the ordinary clamp and suture method, I tried using an ordinary Fergusson clamp, cutting the pile tissue away about  $\frac{1}{4}$  in. distal to the clamp and then stitching these raw edges of tissue together distal to the clamp.

The aim of this operation which is still done by a number of surgeons is the same as mine. My clamp, however, makes possible a much better technic and more perfect end-results.

In dealing with some external-internal hemorrhoids I have used the method of Dr. Vernon David substituting my clamp and suture, however, for the clamp and cautery in dealing with the internal mass and stitching the external incision separately. This works nicely.

The present renewed interest in injection methods and electro-coagulation, which are unsurgical, less safe and not so sure as surgery, is to my mind at least, an expression of revolt against the many unsatisfactory results obtained with the clamp and cautery, Whitehead, or the old clamp and suture methods.

The operation that I have described is so simple that the "occasional operator" can do it as well as the finished surgeon. It is so safe that the operator need have no fear of being called out of bed on account of hemorrhage. It is so satisfactory that the surgeon can feel free in recommending it to his patient as superior to many make-shift procedures now in vogue.

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# NEW INSTRUMENTS

## NEW SURGICAL TOURNIQUET\*

J. CLARK MOLONEY, M.D., AND ALFRED SCHMITT

DETROIT, MICH.

THE ideal surgical tourniquet must meet certain specific requirements: First, it should completely obstruct

projected through the loop of solid rubber cable. This cable is durable, resilient, and measures  $\frac{1}{2}$  in. in diameter. With the

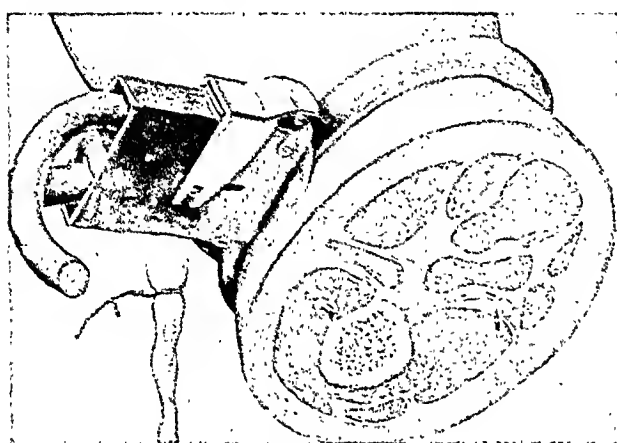


FIG. 1.

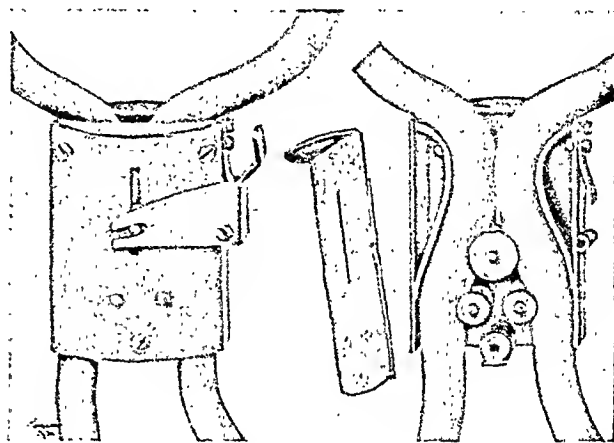


FIG. 2.

the flow of blood. It must not pinch the flesh. Other requisites of importance would include absolute reliability, structural simplicity and ease of application. Provision for a partial release mechanism, so that the arteries might be singled out and ligated, would impart a nicety in design.

The task of constructing a perfect tourniquet is not simple. The number and the varieties of hemostatic contrivances extant will attest not only to the difficulties attendant upon the problem, but also will serve as an index to the numerous minds that have attempted its mechanical solution.

We have designed a new surgical tourniquet. Since the sketches are almost self-explanatory, we will include the description of mechanical detail in our instructions for its application. (See sketches).<sup>1</sup> The limb is

device in position, the ends of the rubber cable are grasped in both hands, and forcibly drawn taut. This puts the loop encircling the limb under considerable elastic tension. This tension forces the strong mechanism, (through which are strung the ends of the rubber cable), against the side of the extremity. The ends of the cable are then released. The elastic recoil of the loop about the limb will pull the center wheel, (which rides back and forth in a slot in the locking mechanism) against the cable where it leaves the device to surround the limb. This securely locks the tourniquet, for, as can be seen from the drawings, that more tension on the encircling loop will only serve to jam the center wheel more firmly against the cable as it emerges from the triangles at the outlet of the contrivance. Following the surgical oper-

\* Submitted for publication March 27, 1930.

<sup>1</sup> For greater description of mechanical details address Henry Ford Hospital, attention Alfred Schmitt, instrument maker.

ation, gentle pressure on the lever at the side of the box, housing the locking mechanism, will force the center wheel away from the cable, thereby causing the cable's release. Incremental release will allow the surgeon

to single out all the arteries as they start to bleed, facilitating their ligation.

This tourniquet is reliable, is simple in structure, is easily applied, and has given satisfactory service at this clinic.



## A SKIN CLIP FORCEPS\*

GEORGE W. SWIFT, M.D.

SEATTLE, WASH.

A CIRCULAR clip made of German silver was devised by Dr. E. Willis Andrews of Chicago for the purpose

use of the ordinary skin clips for a similar purpose. For the past two years I have been using the Andrews clip and find it

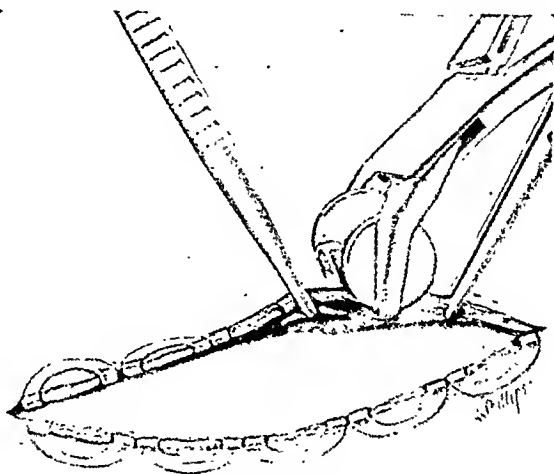


FIG. 1.

of controlling hemorrhage from the small vessels of the scalp in operations upon

very satisfactory. The clips can be put on very firmly, as shown in the illustration,

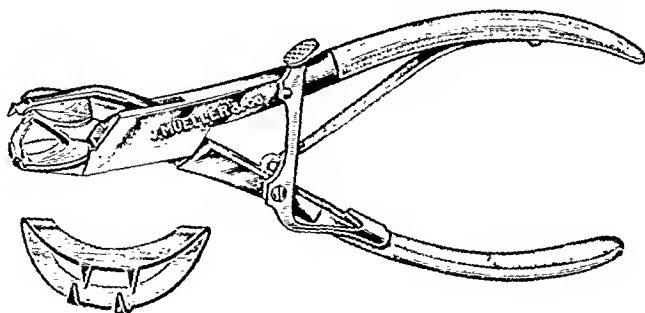


FIG. 2.

the brain. Dr. A. S. Crawford of the Henry Ford Hospital in Detroit had made

and do not cause any slough of the tissue. They do away entirely with the use of a

\* Submitted for publication March 12, 1930.

large number of hemostats which are very cumbersome.

At first a large Kellie forceps was used in compressing the clips. This retarded the operation somewhat and distorted the clips. To a bone rongeur with curved blades was added a metal disc with two prongs behind which the clips were placed by the nurse. This instrument was found to facilitate the use of the clips greatly and to clamp the clips down evenly. When removed they are not distorted as was the case when the Kellie forceps was used.

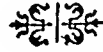
The instrument as illustrated has in addition to the metal disc, an automatic

lock so that the nurse can be adjusting the clip to one instrument, while the operator is applying the clip with the other. This again shortens the time of applying the clips.

An old hemostat is used to remove the clips and the clips can be used for subsequent operations.

The advantages of the skin clip forceps are:

1. Ease in handling the clips.
2. A firm and even closure of the clip on the scalp.
3. The protection of the clip so that it may be used repeatedly.



# CASE REPORTS

## MALIGNANT PAPILLARY ADENOCYSTOMA OF RIGHT OVARY

WITH METASTASIS TO CERVIX\*

LOUIS E. PHANEUF, M.D., F.A.C.S.

BOSTON, MASS.

**M**ETASTASES from a malignant neoplasm of the ovary to the uterine cervix are rather infrequent, hence the reason for reporting this case.

### REPORT OF CASE

*History.* Mrs. M. McD., aged twenty-seven, was first seen on July 29th, 1916. Her complaints were dysmenorrhea and sterility. In 1913 she had had a suspension of the uterus performed but had obtained no relief. Her menstruation was established when she was thirteen years of age; the periods occurred every twenty-eight days; they were scant, lasted two days and were always painful. Dysmenorrhea first appeared at puberty and became worse after marriage. The pain, which began nine days before the onset of the period, started in the lower abdomen, was referred to the rectum, the vagina, the right thigh but not the left, and finally assumed the character of a bearing down sensation. Defecation was painful during the menses. She had considerable leucorrheal discharge between the periods; the bowels were constipated and she had occasional headaches. At the time of the first consultation she had been married six years but had never become pregnant.

*Examination and Treatment.* The physical examination was entirely negative except for the gynecological condition. The pelvic examination, performed under ether anesthesia, showed a marital vaginal outlet and a long conical cervix with a so-called pinpoint os. The uterus was small, in good position from the previous suspension, and the adnexa were normal. The cervix was dilated, a stem pessary was introduced in the uterus and attached to the cervix by four silk worm gut sutures. This

instrument was worn for three months and after its removal the patient menstruated without pain.

She was not seen again until December 7, 1928, twelve years later. She then stated that she had never become pregnant. She complained of uterine hemorrhages lasting twelve days at the periods and of passing large blood clots. The pelvic examination was entirely unsatisfactory because of marked adiposity. The cervix was small and appeared normal. Varicose veins of the left leg were apparent. She was referred to the Gynecological Service of the Carney Hospital where a laparotomy was performed on December 11, 1928.

The post-operative diagnosis was multiple myomata uteri; solid tumor of right ovary, question of carcinoma.

The operation consisted of a supravaginal hysterectomy; double salpingo-oophorectomy, and lysis of adhesions.

A median suprapubic incision was made through a very adipose abdominal wall, entering the peritoneal cavity between the bellies of the recti muscles. The uterus, which was filled with myomata, reached almost to the umbilicus and was firmly adherent to the parietal peritoneum. All adhesions were freed. On the right a solid tumor of the ovary, the size and shape of a kidney, was found; this was absolutely free and its surface was smooth. The right tube and the left adnexa were normal. Aside from the multiple myomata in the uterine fundus, there was a tumor the size of a hen's egg in the cervix at the internal os; this was thought to be a cervical myoma. A classical supravaginal hysterectomy, together with the ablation of the adnexa, was performed. The uterus was amputated below the cervical tumor, cutting into apparently normal cervix. All the pedicles were sutured to the cervical

\* Submitted for publication August 20, 1930.

stump and the raw areas were covered over with the bladder peritoneum. The cervix was not removed because of mechanical difficulties

B. Mallory and the pathological report was, "malignant papillary adenocystoma of the right ovary; malignant papillary adenocystoma

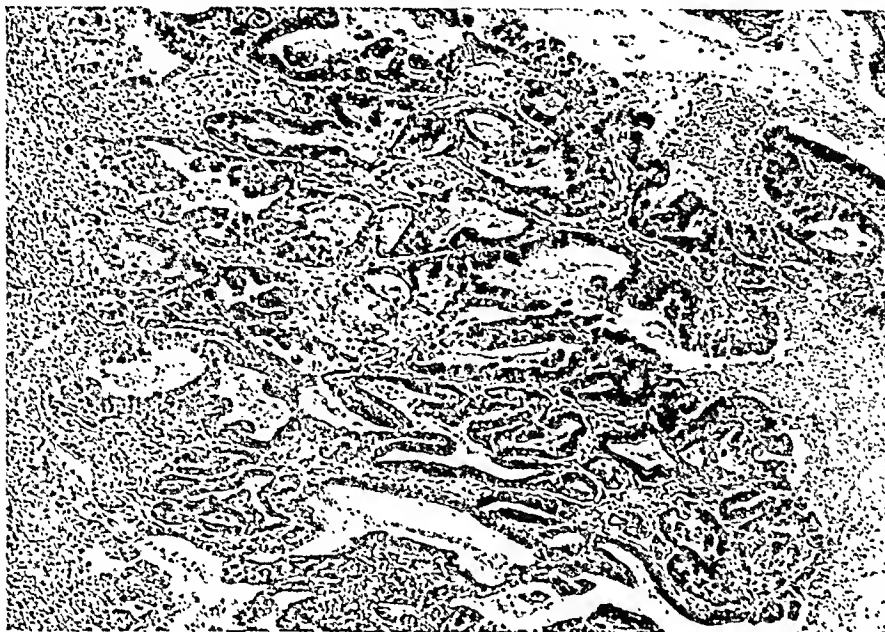


FIG. 1. Wall of tumor of ovary showing papillary out-growths covered with cylindrical epithelium. ( $\times 100$ .)

on account of an extremely deep pelvis, because the patient took the anesthesia badly, and because it appeared normal below the growth

of the cervix, secondary to the ovarian tumor; myomata uteri."

On December 29, 1928 an examination

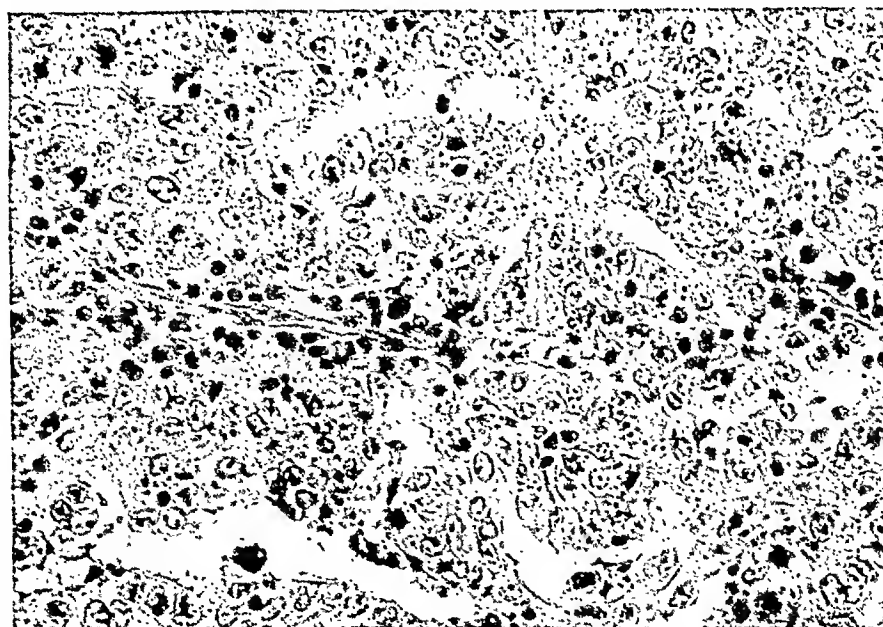


FIG. 2. Same section as shown in Fig. 1, but at higher magnification. Cells are not ciliated. ( $\times 250$ .)

at the internal os. The appendix had been removed at the previous operation. The omentum was brought down and the incision was closed in layers.

The specimen was examined by Dr. Frank

under ether was made. The small stump of cervix looked normal. It was dilated and 50 mg. of radium element filtered through brass and rubber, were introduced in the cervical canal. The radium was left in for thirty-six hours,

giving a dosage of 1800 mg.-hours. This was followed by deep x-ray therapy administered in three sessions.

of cervix left; this is freely movable; all vaults are clear. There has been no bleeding since operation.



FIG. 3. Metastasis of ovarian tumor to cervix. Same type of growth is preserved. One corner shows invasion of muscle tissue of uterus. ( $\times 100$ .)

*Subsequent Examinations.* February 4, 1929. The cervix is atrophied, movable; the vaults are clear; there is no bleeding and no discharge. The patient feels well.

#### COMMENT

In papillary adenocystoma of the ovary, the papillary growths usually pierce the



FIG. 4. Same section as seen in Fig. 3, but at higher magnification to show type of cells lining spaces. ( $\times 250$ .)

On March 8, April 9, May 10, June 12, July 17, August 20, 1929, and January 16, 1930, the examination showed no change from the previous one.

August 15, 1930. There is a small dimple

cyst wall with the formation of peritoneal implants. These may grow rapidly and fill the pelvis. On opening the abdomen, one has the impression that the pelvis is filled with an inoperable cancerous mass.

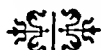
Some such patients get entirely well after the removal of the primary growth. In other cases the growth may become so extensive as to interfere with the function of adjacent organs and cause death. In still other cases malignant change takes place, early or late, and death may result from carcinoma.

In the case reported we were dealing with the malignant form, metastases from the ovarian neoplasm to the uterine cervix having taken place. The cervical metastasis, since it occurred in a myomatous

uterus, was thought to be another myoma. The microscope established the diagnosis.

From the standpoint of treatment a panhysterectomy with the ablation of the adnexa should have been the operation of choice. The patient's condition and the technical difficulties encountered precluded so extensive an intervention. Radium applied to the cervical stump caused its atrophy and no sign of recurrence has been observed after nearly two years.

(I am indebted to Dr. Frank B. Mallory for the photomicrographs illustrating this article.)



## PROLAPSE OF A GASTRIC POLYP INTO DUODENUM WITH MARKED SECONDARY ANEMIA\*

J. WILLIAM HINTON, M.D., F.A.C.S., AND JACOB BUCKSTEIN, M.D.

NEW YORK

**P**ROLAPSE of pedunculated tumors of the stomach through the pylorus has been recently reviewed and elaborated upon by Pendergrass.<sup>1</sup> He stresses the fact that these tumors are prone to ulcerate and may cause a secondary anemia which stimulates the pernicious type. He reports 6 cases in which the anemia was so pronounced that the diagnosis of pernicious anemia had been made before the tumor was demonstrated. Allen in discussing his paper remarked upon the ease with which these tumors slip out of the duodenum into the stomach, and may be overlooked at operation if one is not careful.

### CASE REPORT

Male, aged fifty-one, painter, admitted to the Fourth Surgical Division, Bellevue Hospital, January 2, 1930. Chief complaint: purulent discharge from rectum. Past history: no serious illness or surgical operations. Present illness: patient states that in February, 1929 he had two abscesses around his rectum which ruptured spontaneously and drained for a few

weeks. He had no further trouble until about three months before admission when he began to have a discharge from his rectum, although



FIG. 1. Arrows point to tumor in duodenum.

<sup>1</sup> PENDERGRASS, E. P. Prolapse of pedunculated tumors and gastric mucosa through pylorus into duodenum. *J. A. M. A.*, 94: No. 5, 1930.

\* From the 4th Surg. Div. & Roentgenological Dept., Bellevue Hosp., N. Y. Submitted for publication May 14, 1930.

he did not have another abscess. This continued until his admission to the hospital. Examination: Well developed male, markedly anemic,



the appearance of anemia similar to pernicious type. Chest negative. Heart negative. Blood pressure (110 over 70). Abdomen, no masses of

2,600,000 on five examinations. Hemoglobin 30 per cent. No stippling of the red blood cells or nucleated reds noted. Wassermann test

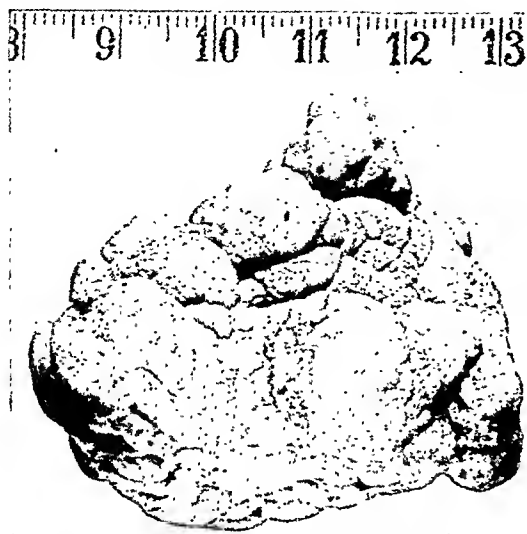


FIG. 2. Ulcerating area on fundus of tumor.

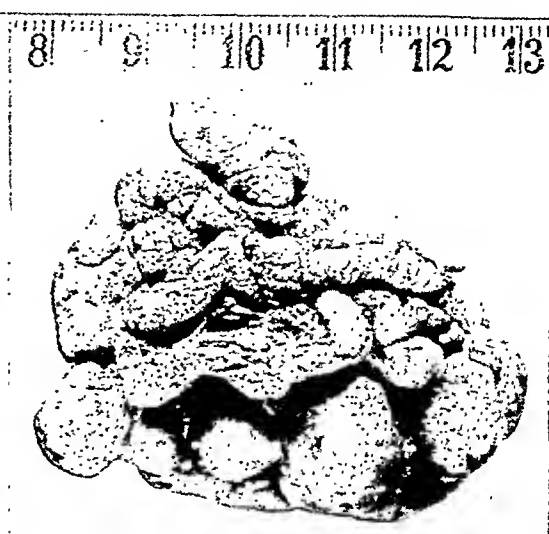


FIG. 3. Pedicle of tumor 3 cm. wide.

tenderness. Liver not enlarged and no kidney tenderness. Rectal examination revealed a fistula on the right side which opened into the rectum. No evidence of hemorrhoids. Clinical diagnosis; Fistula in ano with marked secondary anemia. Due to the marked anemia

negative. Blood chemistry: Sugar 88. Non-protein nitrogen 40. Urea nitrogen 15. Creatinine 109. Uric acid 3.3.  $\text{CO}_2$  combining power 48. Stools negative for parasites or blood.

*X-Ray Examinations:* Barium colonic enema January 7, 1930 failed to reveal any lesions



FIG. 4. General structure of tumor.

this patient was transferred to the Medical Service to exclude pernicious anemia or a heavy metal poisoning.

*Laboratory Data:* The urine examinations were negative. Blood counts revealed leucocytes normal, with a normal differential count. Red blood cells varying from 2,200,000 to

of the rectosigmoid or colon. X-ray examination of lungs on the same day negative. Gastrointestinal x-rays on January 10, 1930 failed to reveal any organic lesion of stomach. Barium on entering duodenum surrounded the outside circumference but the center area remained translucent suggesting the presence of a small

tumor within the duodenum (see Fig. 1). No six-hour gastric retention.

Having excluded pernicious anemia and

bc easily replaced into the duodenum. The pylorus was dilated and would admit two fingers. Excision was done and the base of the



FIG. 5. Low power magnification of tumor.

heavy metal poisoning, and having found a tumor in the duodenum which was probably a prolapsed gastric tumor, we decided that the latter was the primary condition from which the patient was suffering. February 1, 1930 transfused with 500 c.c. of blood. February 20, 1930 transfused with 500 c.c. of blood. Operation February 28, 1930. Preoperative diagnosis: Prolapsed tumor of stomach into duodenum. Under gas oxygen ether anesthesia, abdomen opened through a right rectus muscle splitting incision. On inspection of the pylorus and duodenum there was found in the latter a definite tumor which was soft in consistency and about the size of a small orange. After the bleeders were ligated, re-examination of the duodenum revealed the tumor had disappeared. It could not be felt in the duodenum or around the pyloric region of the stomach, but on palpating the stomach near the cardia, the tumor could be felt. It was found to have a long pedicle and was attached to the greater curvature  $2\frac{1}{2}$  in. from the pylorus. The anterior wall of the stomach was then opened midway between the lesser and greater curvature and the pedunculated tumor was easily delivered and found to have a narrow pedicle. The tumor had an ulcerated area about 1 cm. in diameter over the fundus and could

pedicle found to have very large vessels. The base of the pedicle was sutured with No. 1 chromic gut. Stomach then closed by 3 layers of No. 1 chromic gut. No other intra-abdominal pathology found. Abdomen closed in anatomical layers.

*Postoperative:* Patient's condition was satisfactory on March 1, but he was transfused with 500 c.c. of blood, due to his previous anemia. On March 2 the patient's pulse was rapid, face flushed, and there were râles at the right base. Diagnosis of pneumonia made. On March 3 his condition became gradually worse and he died the same day.

*Pathological Report:* A tumor the size of a small orange with convoluted surface and a small ulcer 1 cm. on the fundus with a definite pedicle was distinguished. The gross appearance is seen in Figures 2 and 3 and the microscopic picture in Figures 4 and 5.

#### REMARKS

This case was extremely interesting due to the fact that the patient entered the hospital for a fistula in ano and had no complaints referable to his stomach. On being carefully questioned, after the tumor had been demonstrated, the patient persistently denied any gastric distress.

# UROLOGY IN CHILDREN

## TWO CASE REPORTS\*

P. M. BUTTERFIELD, M.D., F.A.C.S.

NEW YORK

THE 2 cases here reported are fairly representative of the conditions we see and the work we are doing in



FIG. 1. Case 1. Calculi in kidney, ureter and bladder.

child urology at the New York Hospital. They are presented because they have been under observation for some time and hence give some idea as to what may be accomplished in the care of children suffering from urological lesions.

CASE 1. Urolithiasis in a boy of nine months.

(D. B.), male, aged nine months. Family history irrelevant. Birth normal. Bottle fed with difficulty in selecting suitable formula.

First seen in May, 1925 with a history of

blood, shreds in the urine and bearing down on voiding for the past two months. No chills, occasional slight fever.

He was cystoscoped under ether anesthesia, the infant cystoscope passing easily after a preliminary meatotomy.

A calculus the size of the thumb was seen in the bladder whose mucosa was the seat of an intense bullous edema. Bladder cultures were negative. Phenolsulphonephthalein output was 35 per cent in two hours.

X-ray showed a calculus in the pelvis of the left kidney and three calculi in the bladder or the ureter.

He was then sent to the medical department as a feeding case, the bladder lavaged with acriflavine daily and acid sodium phosphate and methenamine given by mouth.

In June, 1925 a suprapubic cystotomy was done and four stones removed from the bladder.

X-ray before leaving the hospital showed three calculi in the lower left ureter and none in the bladder.

In the fall of 1927 there was a recurrence of his former symptoms. X-ray showed three renal and one bladder stone.

In November, 1927 a second suprapubic cystotomy was performed and one large stone removed.

In August, 1928, when he had arrived at the operative age of four, he was again x-rayed and three calculi found in the left kidney.

These were removed by nephrotomy. Subsequent x-rays taken at six-month intervals show no recurrence of calculi.

The regulation of his diet and the continuous administration of acid sodium phosphate are thought to be important factors in keeping him stone free. All the calculi removed proved to be of the calcium phosphate and carbonate variety.

This child made a rapid and uncomplicated recovery after each surgical procedure. In general the results of necessary surgery in child urology have proved to be most gratifying and the mortality negligible.

Bugbee and Wollstein in their study of autopsy material at the Babies Hospital

\* From the Department of Urology (James Buchanan Brady Foundation), New York Hospital.

Read before the Section of Genito-Urinary Surgery, New York Academy of Medicine, May 21, 1930.

found that nephrolithiasis accounted for 11 per cent of the congenital anomalies of the urinary tract. All of the subjects were

General condition excellent. No renal tenderness. Slight constipation, frequent colds and slight nasal obstruction.

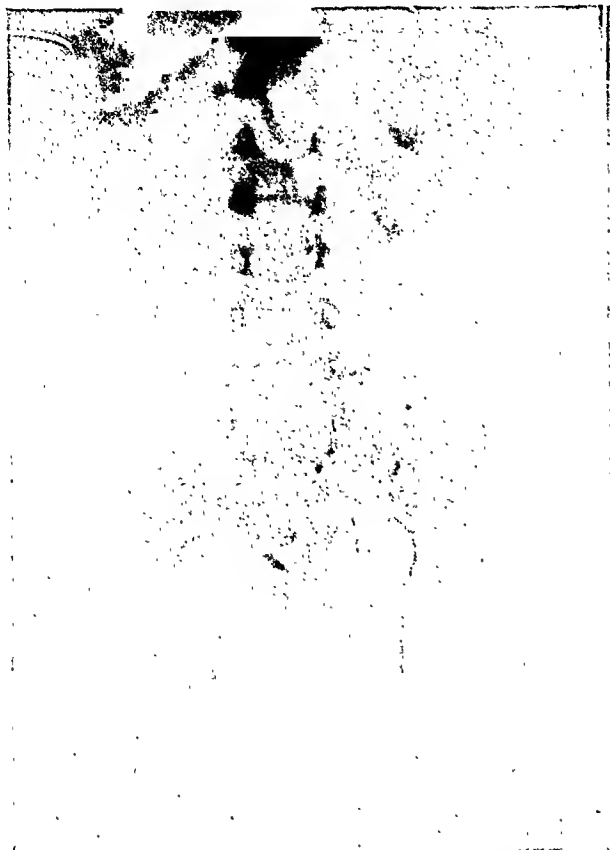


FIG. 2. Case 1. Calculi in kidney and bladder.



FIG. 3. Case 1. Calculi in kidney.

under one year of age and one was eleven days old. Urinary calculi are very common in children and the majority require surgical attention. The diagnosis is simple and the results of surgery are most satisfactory.

I am indebted to Dr. O. S. Lowsley for his permission to report this very interesting case.

**CASE 11.** Double kidney with infection in a girl of five years.

(P. M.) Female, aged five years. Normal baby. Pertussis, mild, at seven months. Tonsillectomy at three. Enuresis up to fourth year. From her second to third year several transient attacks of frequent urination relieved by the use of potassium citrate.

In December, 1927 sore throat, fever, frequent urination, confined to bed for ten days and weak for a month. Mild measles in the spring of 1928. In July, 1928 transient headache, pain in both flanks and frequency.

She was first seen in August, 1928. Chief complaint, occasional frequency and fever.

The catheterized specimen of urine was clear, free of albumin and sugar and the sediment showed a few pus cells and no organisms. Methenamine was given  $2\frac{1}{2}$  grains t.i.d.

She was seen again in November, 1928, was apparently perfectly well, had no urinary disturbance, had gained in weight and the catheterized urine was free of pus.

In the winter of 1928-9 she had three attacks, lasting from two to seven days of slight fever, drowsiness and frequency of every half hour. In the following spring similar attacks occurred monthly.

She was seen in June, 1929 a few days after a three-day attack. She was well nourished but rather pale. The catheterized urine showed abundant pus and bacilli. She was placed on alkaline medication and two weeks later entered the New York Hospital for study.

Cystoscopy and pyelography were carried out under ether anesthesia. Our child cystourethroscope entered easily. Vesical orifice slightly thickened, smooth. Vault negative. Fundus slightly trabeculated. Trigone hyperinjected. The interureteric ridge slightly hypertrophied.

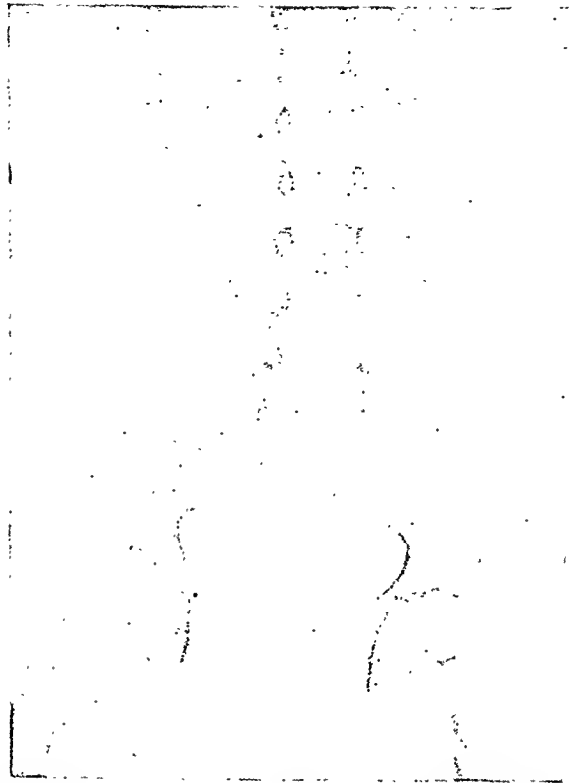


FIG. 4. Case 1. Stone free eighteen months after nephrotomy.



FIG. 5. Case 11. Upper pelvis of double kidney.

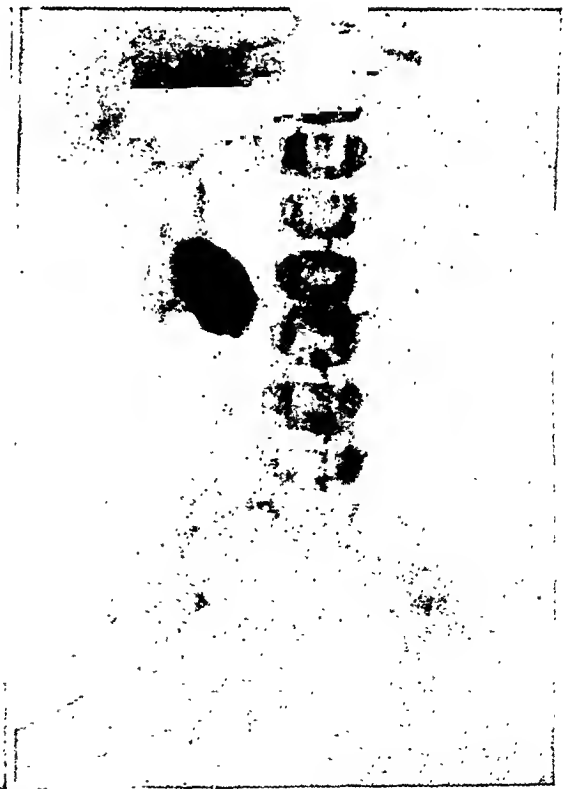


FIG. 6. Case 11. Lower pelvis of double kidney.

The left ureteral orifice is normal in location and appearance and is easily catheterized to the kidney. The right ureteral orifice is normal in location and appearance and is easily catheterized to the kidney. Specimens were collected for culture. On further examination a second right ureteral orifice was found just above the first and after filling the pelvis, connecting with lower orifice with 5 c.c. 20 per cent sodium iodide and getting an x-ray, the upper right orifice was catheterized and another pyelogram taken using the same technic.

Cultures from the bladder, left kidney and both right pelves showed *B. coli*.

The first picture of the right pyelogram showed a typical T-shaped pelvis characteristic of the upper pelvis of a double kidney. The second pyelogram, showing the lower pelvis of a double kidney revealed a markedly dilated pelvis with dilatation of the major and clubbing of the minor calices. There was a right angle kink at the ureteropelvic junction and an area of stricture of the ureter opposite the transverse process of the third lumbar vertebra. The ureter below this area is markedly dilated.

She was discharged two days later with instructions to take pyridium grain 0.05 twice daily. She remained very well until three weeks later when she had a rise in temperature and frequency with hazy urine.

A week later she again entered the hospital and the hydronephrotic sac lavaged with rivanol-dextrose and a No. 6 ureter catheter left *in situ* for twenty-four hours.

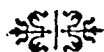
Following this treatment she has been in

excellent health. Her weight has increased 6 lb. in the past year. Her color is normal. She voids every two to three hours during the day and has a nocturia of 1-2. She had a lobar pneumonia in January, 1930 without any disturbance of the renal condition except for a slight increase in frequency. Since the lavage she has had none of the old feverish spells. A specimen of urine obtained May, 1930 shows a few pus cells and many bacilli.

In this case we have not accomplished a cure. We have merely improved the drainage of the hydronephrotic pelvis. She will be kept under observation, lavaged and dilated if there is a return of fever, urinary antiseptics will be continued and finally, if the pyuria and bacteriuria continue a pelvic plastic procedure or a heminephrectomy will be advised.

Let me again call attention to the fact that these children stand cystoscopy, pyelography and renal lavage extremely well. Chills, fever and pain are entirely absent in the recovery period.

Further this case illustrates our dictum that every child with a persistent or intermittent pyuria should have a complete urological examination. In all such cases renal tuberculosis and congenital anomaly should be borne in mind in addition to extrarenal sources of urinary tract infection.



# GIANT BILATERAL URETERAL CALCULI

## A SURGICAL CURIOSITY\*

AUGUSTUS HARRIS, M.D., F.A.C.S.

BROOKLYN, N. Y.

MISS M. M. referred by Dr. R. G. Price, consulted me in March, 1930, complaining of marked frequency and urgency of urination. She also experienced considerable annoying pain in the lower abdomen when walking. The urine contained a large amount of pus and was somewhat ammoniacal. Gross hematuria was never seen by the patient. She appeared to be very neurotic and had apparently suffered a great deal.

Ten years ago she was operated upon and a calculus removed from the right kidney. At that time she had severe colic two days after leaving the hospital, but thereafter she had relief until three years ago when the severe bladder symptoms returned. Local bladder treatment gave a considerable measure of relief for a time, and then radiographs were taken which showed a very long irregular cast stone of the lower ureter on both sides, also a dendritic stone of moderate size in the right renal pelvis and calyces.

Careful search was made for tubercle bacilli in the urine on two occasions and found negative. (Her father had died of pulmonary tuberculosis.) There was very little loss of body weight. She had headache frequently. The menstrual function was normal.

Physical examination was essentially negative excepting for slight tenderness on deep pressure along the lower ureters and bladder region. There was no renal tenderness, nor could either kidney be felt.

**Cystoscopy:** Acute and chronic generalized cystitis was found with numerous hemorrhagic areas. The ureteral meati appeared practically normal. A No. 6 F opaque catheter passed readily on the right side beside the ureteral calculus after temporary obstruction. There was no evidence of hydronephrosis on this side. The phenolsulphonephthalein returned in four and one-half minutes and 17 per cent was recovered in the first twenty-five minutes. The urine showed a small amount of pus with *Bacillus coli* and *micrococcus ureae*. All catheters on the left side, however, failed to pass more than 8 cm. after repeated attempts. A small amount of cloudy urine was recovered

and found to contain considerable pus. It was obviously impossible to obtain the function of the left kidney. The pulse was a little rapid but of good quality and the blood pressure normal. The blood chemistry was normal excepting for slight increase in uric acid. There was also a slight anemia.

After a careful consideration of these findings, we determined that we had nothing to offer her other than to provide for free ureteral drainage by means of a two-step ureterotomy and removal of the ureteral calculi. She was young and in fairly good condition, and we realized that she could not continue for long with such obstruction in the upper urinary tract.

Ureterotomy was performed first upon the right side, as we knew its approximate functional capacity, and knew little or nothing of the left because of the catheter blockage. Accordingly a few days later a right rectus incision was made, the parietal peritoneum dissected away toward the midline, and the ureter readily exposed. It was very large and thick and easily isolated with the large stone within. An incision about  $2\frac{1}{2}$  to 3 cm. long was made in the anterior wall and the stone gently grasped with forceps. It was very friable and the tip broke off; but, with care, we managed to deliver the balance of the stone in toto. After thorough irrigation of the ureter with a large catheter we found there was no obstruction at the lower end. It was then closed with 6 or 7 interrupted No. 0 catgut sutures passed through outer coats and the wound closed in the usual manner leaving two large cigarette drains in the bed of the wound. These were removed, in part, between the third and fifth days and the last piece on the sixth day.

This procedure only required about thirty-five minutes and the patient was returned to bed in good condition. After the third day the wound was entirely free of urinary leakage and healing took place rapidly. It was interesting to note the symptomatic relief after operation and how rapidly she improved.

Nine days later a left ureterotomy was

\* Read before the Brooklyn Urological Society, April 8, 1930.

performed for the second calculus. The procedure on this side was similar to the previous one excepting that it was somewhat more difficult (requiring fifty minutes). After the ureter was incised the stone was crooked at the lower end like a hockey-stick and could not be removed excepting with the aid of the pressure of the index finger at the lower end of the stone with traction on the upper end of the stone. The ureter was thick-walled and as large as the small intestine. It was then irrigated and no obstruction found at the lower end. Argyrol solution was instilled into the left renal pelvis. The ureter was then closed tightly and two periuréteral drains inserted as in the first procedure, and wound closed in the usual manner.

The early convalescence was satisfactory after the second operation. Intravenous glucose and hypodermoclyses were given. There was moderate leakage of urine for about five days from the left ureter which gradually closed. Her temperature became normal and she took nourishment fairly well. Urinary output after both procedures was very satisfactory.

On the morning of the eleventh day after her second operation while sitting up in bed on pillows, she very suddenly developed an attack of weakness, shallow breathing and thready pulse. She ceased to breathe within a few minutes even though hypodermic stimulation was given.

This came out of a "clear sky" when we were about ready to allow the patient out of bed. Her quality of pulse for days before gave no warning whatever of such a catastrophe. We concluded she must have died of embolus.

The calculi were of brownish color and very friable, like chalk. Analysis showed calcium carbonate.

#### COMMENTS

In reviewing the literature, we have been able to find the report of but one other case of giant bilateral ureteral calculi. This is recorded by Dr. Wm. E. Stevens. Despite this fact, about 10 per cent of the cases of ureteral calculi are said to be bilateral.

A very limited number of cases of very large unilateral ureteral calculi are recorded. The available references to these are given later. It is worthy of note that the majority of these have occurred on

the left side. Some have been removed through simple extraperitoneal ureterotomy; others have required transperitoneal

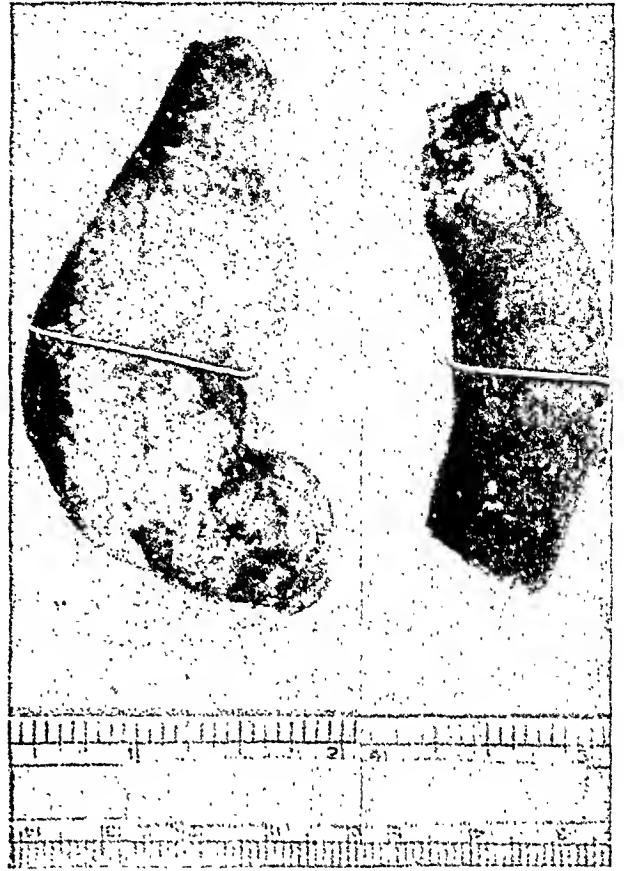


FIG. 1. Giant ureteral calculi removed from lower ureters (actual size). Goodly portion of right-sided stone taken for chemical analysis.

ureterotomy; still others have required nephrectomy. Some have needed nephrectomy at a later date when a small stone had been left in the ureter.

An interesting case report by Carson (two large stones in one ureter) required four operative procedures: 1. Nephrostomy for drainage of acute pyonephrosis. 2. Ureterotomy for stone removal one week later. 3. Nephrectomy two weeks later. 4. Ureterectomy for discharging ureteral stump four months later, with recovery. This last case illustrates the value of present-day "stepping up" operations in renal surgery, and also indicates the wisdom of the operator in not trying to do too much at one time. In many cases of calculi the acute septic condition must first be relieved.



A striking example of clever and conservative surgery is shown in the case of W. Walters. He performed ureterotomy

There is no question but that there is a growing field for this sort of management, and that lives have been sacrificed in



FIG. 2. Giant ureteral calculi (taken June 1928).



FIG. 3. Giant ureteral calculi (taken March 1930).  
Note increase in size of calculi.

for the removal of seven stones of .5 to 2 cm. in diameter accompanied by pyo-

many instances in the past because of too much surgery at one sitting.

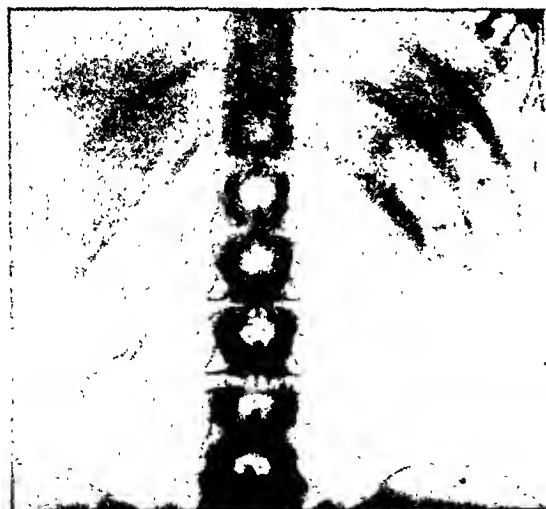


FIG. 4. Dendritic calculus in right kidney (taken June 1928).



FIG. 5. Dendritic calculus in right kidney (taken March 1930). Note marked increase in size.

nephrosis. He dissected the ureter free and brought it out in the flank and later performed nephrectomy with recovery.

While simple nephrectomy for pyonephrosis resulting from calculus in the lower ureter may cure a certain number of

cases, others undoubtedly are likely to have trouble with the remaining infected ureteral stump containing the calculus. A preliminary ureterolithotomy in certain instances seems logical and necessary before a permanent cure may be expected from nephrectomy. In a given case of ureteral calculi, all factors must be carefully reviewed and weighed by the operator before any procedure is decided upon, especially in the presence of advanced renal pathology.

After extraction of stones from the ureter we believe that the latter should be sutured carefully with fine plain catgut. Repeated experience in pyelotomy and ureterotomy procedures in our own practice bears out this point. The contention by some that the use of sutures invites delayed healing and tendency to fistula formation, is not well founded.

It is interesting to note that a number of these giant ureteral calculi failed to give colic. In some of them ureteral catheters passed to the pelvis without difficulty. A goodly number of the recorded cases had had a previous "insufficient" appendectomy, an experience so commonly found in all types of renal and ureteral calculi. Buerger described 2 cases of very large unilateral ureteric calculi, accompanied by a large amount of periureteral fibrolipomatous formation. This is important especially in regard to

prospective difficulty in ureterotomy or ureterectomy in a chronic case. Many experienced surgeons have encountered similar pathology about the pelvis in very old stone cases. Berry has recorded an instance of spontaneous perforation of a ureter by a stone with resultant extravasation of urine, sepsis, uremia and death.

One of the largest of ureteral calculi is that recorded by Jefferson, weighing 1639 grains. Collinson's case was almost a complete cast of the ureter. Federoff's case measured 19 cm. in length. Very little is given regarding the chemical analysis of these giant calculi. It is worthy of note also that in some of the cases, the stone was somewhat s shaped or hooked shaped. This could easily add materially to the difficulties of surgical removal.

All urologists appreciate the formidable problems presented by multiple urinary tract calculi and their tendency to recurrence. While obstruction and stasis are proved factors in the etiology, we believe that these factors are almost the exception to the rule, particularly with stones in the upper urinary tract. The chief cause may be summed up in two vague words "faulty metabolism." Our hope lies in an ever-widening knowledge of body chemistry, to make possible the prevention of stones and elimination of mutilating surgical procedures.

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## MOMMSEN'S METHOD OF SUBMAXIMAL STIMULATION FOR TIBIAL PSEUDOARTHROSIS\*

ARTHUR KRIDA, M.D., F.A.C.S.

NEW YORK

IN 1929<sup>1</sup> Mommson published a method of submaximal stimulation of ununited fractures of the tibia and reported 4 successful cases. In this paper he shows that the relatively maximal stimulation involved in weight bearing, even with the protections of a brace, may convert a delayed union into a pseudo-arthritis. He devised a variation of the well-known hammer and dam method of Thomas which is simple of application and seemingly more effective.

The method consists in the intermittent application of a submaximal stimulation of the fracture by light blows on the bottom of the heel. A hammer is slung on a pin; a string is attached to the handle of the hammer, and with this the patient stimulates his fracture by repeated blows of the hammer. The limb is encased in plaster of Paris, the hammer device is incorporated in it, and a fenestrum is made, exposing the heel. The patient does the hammering systematically for five to ten minutes every waking hour, for one to two months.

Since the train of events and the outcome parallel the reported cases, I am showing this case here.

P. A., aged thirty-seven, Seaman, U. S. Marine Hospital No. 43.

*History:* August 1926. Simple fracture lower third tibia and fibula. In plaster three months. Non-union.

December, 1926. Sliding bone graft, elsewhere. In plaster three months plus.

July, 1927. Discharged, union reported. Returned to work. Ten days later, pain and swelling.

*Operation:* (elsewhere), August, 1927. Lane plate. Plaster three months followed by caliper brace. Lane plate removed.

November, 1927 to December 1928, in hospital, wearing caliper brace.

December, 1928, examined by myself; non-union with considerable outward bowing. Extensive scar with chronic dermatitis. Operation for correction of deformity, as it was felt that no bone graft could be done through the extensive scar.

May, 1928, discharged to return to work, partial union. Worked three weeks, then

\* Presented before the Section of Orthopedic Surgery, New York Academy of Medicine, February, 1930.

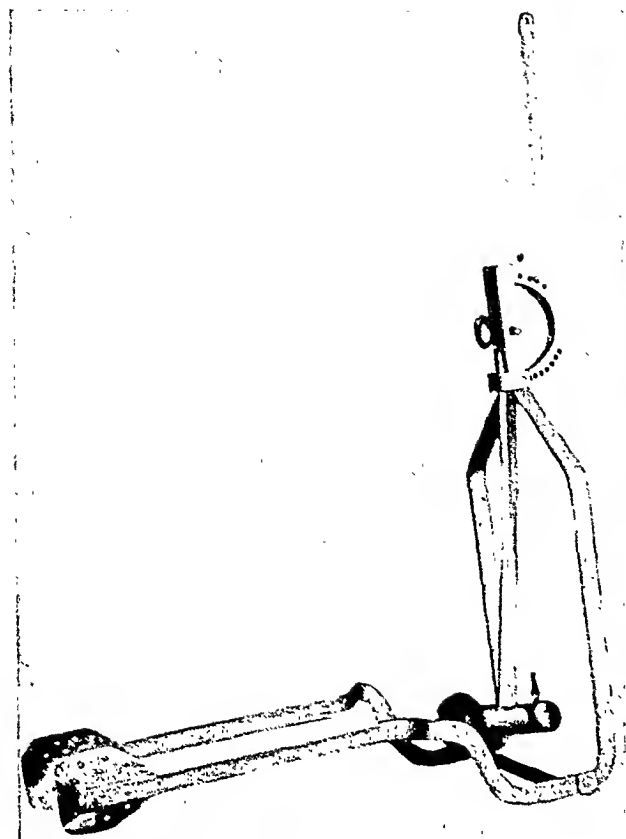


FIG. 1. Mommsen's hammering device for sub-maximal stimulation.



FIG. 2. Non-union of tibia.



FIG. 3. X-ray after eight weeks of hammering by Mommsen's method, followed by four months' walking without protection.

returned with pain and swelling and a discharging sinus.

August, 1929. Mommsen's hammering device applied. Hammering maintained for five minutes per hour for eight weeks.

October, 1929. Examination by Chief of Surgical Service, Marine Hospital: union solid, no pain. Allowed to walk.

February, 1930. Examination (Krida). Has been walking without support for four months without pain. Union appears to be firm. X-ray shows tibial fracture about two-thirds obliterated by mature callus.

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#### DISCUSSION

DR. MATHER CLEVELAND: The condition of the skin which Dr. Krida pointed out is an interesting complication that we see frequently in these cases of non-union. We have had several at the Orthopedic Hospital which have been helped by a pedicle skin graft, removing all of the scar and fibrous tissue before doing any work on the bone. The circulation is thereby improved very considerably.

DR. EDGAR OPPENHEIMER: I think the attempt to get the patient to walk early is important. When the leg is held securely in a tight cast the weight bearing is equivalent to the hammering done here with a mallet. By this means we each turn a large portion of non-unions into delayed unions, adequate consolidation taking place after ten months. I believe this to be a local reaction and that constitutional means are of little value, such as attempts at increased calcium deposit.

DR. GEORGE R. ELLIOTT: I would like Dr. Krida to tell what jolting apparatus Dr. Mommsen uses for non-union of the upper extremity or what he would himself suggest.

DR. KRIDA, closing: With regard to the procedure of what might be called submaximal stimulation of delayed union of bone elsewhere than in the tibia, I would say that Mommsen's experience was based on four fractures of the tibia. Of course the femur has been treated by Thomas's method for many years. It seems to me that Mommsen's method is an advantage, and that his apparatus might very well be used for fractures of the shaft of the femur. I have not at the present time a case of non-union of the upper extremity bones, but if I should get one I will try to rig up some apparatus to apply this sort of force.



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## EDITORIALS

### EARLY TREATMENT OF CONGENITAL DISLOCATION OF THE HIP AT THE ISTITUTO ORTOPEDICO RIZZOLI

THE Clinic of Professor Vittorio Putti at the Istituto Ortopedico Rizzoli, Bologna, has won the respect and admiration of the orthopedic surgeons of this country and abroad through its surgical accomplishments that are too well known to need any introduction whatever. The activities at Rizzoli are very numerous and of such magnitude that they would require intensive study for us to appreciate their extent and character. As it would be inappropriate to attempt a summary of them I shall limit my remarks to the one subject that Prof. Putti considers very important and very interesting namely: congenital dislocation of the hip.

Visitors to Rizzoli will never be dis-

appointed in all the nice things they have heard in praise of the institution, and I am sure they will never leave without the firm conviction that their most ardent supporters could not describe, in word or in picture, the charm and beauty of this wonderful institution poised on the top of a wooded hill in the outskirts of Bologna. They are prepared to see a great surgeon exhibit the skill that but few men possess, but I am sure very few anticipate the full pleasure that waits them during their visit. With their feelings of regret in leaving, is the perfect satisfaction of having seen a great man and a great institution.

Rizzoli receives its name from the founder, Dr. Francesco Rizzoli, an eminent

surgeon of Bologna, who conceived the idea of a special hospital devoted to the principles of orthopedic surgery. He deeded to the city of Bologna sufficient funds to purchase the present site of the institution. The buildings were converted from an old monastery formerly occupied by the Olivetan Monks and parts of the structure, erected as early as the middle of the fourteenth century, are still in an excellent state of preservation. Aside from the necessary improvements to bring the buildings up to date, there have been no serious alterations of the original plans of the monastery, a fact that adds greatly to its present attraction.

The success of carrying out the ideas of the founder can largely be attributed to Prof. Alessandro Codivilla, whose guidance and personal services played a conspicuous part in the early organization and subsequent development of the hospital. He continued his great work as Medical Director until 1912 when the responsibility was passed to his very able assistant, Prof. Vittorio Putti, who has carried on the work with notable success.

Since the death of Codivilla the work has continued and the institution has grown in size and importance. The many achievements of Codivilla in bone surgery, tendon transplantation and congenital dislocation of the hip, etc. play an important part in the theories and technique that govern in the institution today. They have been supplemented by the many contributions of Prof. Putti and brought to the high degree of perfection that has earned for it the enviable reputation of the "best orthopedic hospital in Europe."

Rizzoli is more than a hospital; it is an institution of a national character. It was conceived with a generous motive, fostered in an atmosphere of medieval charm and guided through its years of development by men of great ability who inherited their traditions and learning from the famous medical school of Bologna, of which it forms a part today.

There is something about the institution

that is different, something that is impressive. An atmosphere of romance is evident about the old monastery buildings and the beautiful grounds. The old cloisters and former dormitories attract attention and imbue us with a sense of reverence. There is calm dignity in the manner and appearance of the members of the organization and, in the wards, and in the various departments of the institution, there is noted an expression of efficiency that is without deliberation or effort. An unseen force directs the activities of the hospital and finds expression in the spirit and personality of the staff. It is a "one man show" and the driving force is Prof. Putti.

He has a courteous and friendly manner and takes great pleasure in receiving the many visitors who come to Rizzoli from all parts of the world. He is untiring in his capacity for work not only as Surgical Director, but also as efficient administrator of this institution, which takes a fair amount of his attention. After speaking with him and seeing him work, it is quite easy to form the impression that you have met with a genius in the conception of the broad principles of orthopedic surgery, and an artist in the execution of its technique. He takes great pleasure in discussing the interesting buildings or surgical activities that appeal to his visitors, but the subject that arouses his greatest enthusiasm is: *congenital dislocation of the hip*.

Visitors are impressed with the great number of patients who apply for treatment at the Istituto Rizzoli. Between 1899 and 1927 there were 2578 patients in whom 3685 dislocations were treated. A review of the statistics furnished by Prof. Putti makes it apparent that this abnormality is far more frequent in Italy than in America. It may be further observed, that patients come to Rizzoli from all parts of Italy. This abnormality is met most frequently in the northern provinces, to a lesser extent in Sicily, while in the extreme southern part it is infrequently reported. The geographical

distribution in Italy compares to a similar distribution reported in the southern departments of France.

The localization and frequency of its occurrence have not been clearly explained, although the observation has been amply verified. Knowledge of the deformity seems to be prevalent among certain sections of the population in Italy and is passed from one generation to another, along with the mysteries of folk lore and superstitions. Fear of its presence may cause the young mother to suspect the deformity at the age of walking, and in certain instances at an earlier period. The hereditary and familial characteristics of congenital dislocation of the hip keep the parents in these sections alive to the possibility of its occurrence, which aids materially in the early diagnosis of the deformity. Recent reports from the institution published in November, 1929, show a direct heredity in 6.5 per cent and a familial occurrence as high as 16.9 per cent.

While these facts are of interest in aiding the early diagnosis, they are, in a measure, somewhat minimized in importance by the very constructive and efficient campaign of education that was begun over ten years ago. With the untiring efforts of Prof. Putti it has been carried on through the co-operation of medical and surgical societies, colleges, schools, health workers, nursing and lay organizations to bring to the attention of all parents the prevalence of its occurrence, its diagnosis and the means by which the child may secure treatment at the earliest possible age.

There is a concerted effort to recognize and treat the deformity at the minimum age period. By this means Prof. Putti hopes to controvert some existing beliefs, in regard to the treatment, that will bring the deformity in line with the management of congenital abnormalities found elsewhere in the body. It is most gratifying to find that the campaign is already bearing fruit, as the recent reports show definite progress in lowering the minimum age period when treatment was established.

Forty-seven per cent of cases were treated before the termination of the third year. Two and one-half were treated before the termination of the first year of life, while between the ages of three and six 29 per cent were treated. These figures demonstrate the success of his efforts to place the treatment of congenital dislocation on a scientific basis. It also emphasizes, that greater success may be expected as the educational propaganda becomes more widely known.

A careful review of the report shows a similarity to the figures reported from other sources in which the female sex predominates in a ratio of about 5 to 1. It differs in the fact that bilateral dislocation was found in 42 per cent of the cases, which is somewhat higher than the figures of other clinics. This has led Prof. Putti to believe that this group is more frequent in its occurrence than is generally believed.

#### PHYSICAL SIGNS

The early physical signs may be detected by encouraging the mother to relate fully the peculiarities she has noted in the actions of the child. Too much emphasis cannot be given to this method of examination, as it is often found that the clue to the deformity comes from the mother. She may state that the child shows a disinclination to use the leg with the same freedom as the normal one. This may be seen during bathing or dressing when it is more evident than at any other time and if an attempt is made to stand the child on its feet, weight bearing is avoided. A delay in the usual time when walking should begin is often an incentive to bring the baby for examination.

An examination at this time shows the presence of irregularities in the inguinal and gluteal folds and in the skin fold of the leg. On the side of the deformity there is an increase in the number and a proximal displacement of the folds of the leg as compared to the normal side. The inguinal fold is deeper and



longer on the dislocated side and on the posterior surface of the pelvis it may be noted that the gluteal fold extends further outward toward the lateral surface of the body. The subcutaneous tissue of the buttock is not quite so firm and the feel of muscle tone is not as noticeable as on the normal side. The outline of the trunk and extremities shows an angulation at the trochanteric line instead of the graceful curve of the normal hip and thigh.

Examination of the hip, with the knee extended, shows a restriction of motion in abduction and internal rotation. It is more easily detected by grasping the flexed knees in both hands while abducting and rotating the thighs. In either of these positions there is a distinct resistance in the abnormal hip that is easily felt. In very young children great reliance cannot be placed on one's ability to determine the absence of the femoral head anteriorly or its abnormal position posteriorly, as these are uncertain tests in infants, especially under the age of one.

It is more difficult to make the diagnosis of bilateral dislocation in the very early cases. However, if one trains his eye to observe the following signs he may note evidence that makes the diagnosis more than a suspicion.

1. In the erect position it is observed that the internal margins of the thighs do not come in contact with one another at the perineum.

2. The profile of the hips shows a curve less uniform.

3. The inguinal folds are definitely increased in depth.

4. Both extremities are externally rotated, a very important sign and in itself, of sufficient importance to suggest an x-ray examination of the hips.

#### X-RAY EXAMINATION

The x-ray is an invaluable aid in the very early diagnosis and the characteristics of the deformity may be detected with practice and experience. The unusual ability possessed by Prof. Putti in the

interpretation of the x-ray film has contributed greatly to the early diagnosis of the deformity. It is by this method of examination that he hopes for even greater success in the future.

The points of importance in the interpretation of the x-ray are the following:

1. Alteration of the angle formed by the roof of the acetabulum.

2. Absence or diminution in size of the nucleus of the center of ossification of the femoral head.

3. Changes in the contour and position of the femoral head in its normal relation to the acetabulum.

After the age of walking additional physical signs may be noted in the presence of an abnormal gait, positive Trendelenburg sign on the side of the deformity, the detection of the abnormal position of the femoral head of the femur and the inequality of the length of the extremities. It is between the age of walking and up to the end of the third year that the majority of cases are treated.

#### TREATMENT

*Prolonged Abduction:* The treatment of congenital dislocation offers an orderly sequence of thought in the application of the various methods available. In general it may be stated that children under one year of age are not desirable subjects for manipulative reduction nor, in the mind of Prof. Putti, is the manipulation indicated. From experiences and practice it has been observed that excellent functional and anatomical results can be obtained by placing the legs in full abduction and maintaining this position for a sufficiently long period to keep the femoral head in contact with the acetabulum. Six to eight months is the practice at present and as further experience is gained a more definite period may be determined upon. In this regard Prof. Putti feels that spontaneous reduction is even possible in certain instances.

The child is placed in a position of extreme abduction at the hip joints which

is maintained by a triangular mattress securely strapped to the child's legs from the pelvis to the feet. It is worn continually and removed only for the demands of nature. These children may be seen about the clinic suspended from the mother's side, her arm about the child's axilla and the legs held fully abducted across the mattress. There is not the slightest evidence of discomfort to the child and no apparent hardship to the mother in following this method of treatment.

Prof. Putti recently reported on these cases at the joint meeting of the British and American Orthopedic Societies held in London last July. At that time he expressed his views on the results of the treatment and I am sure his confidence in, and satisfaction with, the method is well known to you.

*Treatment by Manipulation:* Manipulative reduction is the method of choice below the age of three years, although in exceptional cases it may be used in children up to six or seven. In the latter cases it is undesirable because of the necessary trauma usually associated with forceable manipulation of the femoral head into the acetabulum.

This conservative method of treatment meets with the full requirements for the excellent results they have thus far obtained, except for a very small percentage of cases treated by open surgical reduction. The technic of the manipulation is that described by Paci and has been used in the cases reported by both Codivilla and Putti. The manipulation of Paci is short and is performed as gently as it can possibly be done and is not preceded by the prolonged stretching of the peri-articular structure as in the case of the Lorenz method. The time consumed is, on the average, less than two minutes from the beginning of the manipulation to the application of the cast. The apparent ease of reduction is most impressive and, though the time consumed in the manipulation is very short, there is no appearance

of haste or of excessive force in the movements. After the reduction the technic follows that of Lorenz with certain modifications.

*Immobilization:* In the first position of immobilization the leg is placed at 90° flexion and full abduction with slight external rotation, which position is maintained for three months. In bilateral cases both legs are enclosed in the cast and in unilateral cases one leg is immobilized, with the cast extending from the costal margin to the lower third of the leg.

The second position of immobilization reduces the angle of flexion about 25°, and with it the position of abduction is lessened while the thigh has been changed from external to internal rotation. This second position is also maintained for three months during which the child is given certain freedom of position, by being allowed about the wards in specially constructed chairs.

The intermediate stage between the first and the second positions, which is from five to seven days, permits the gradual change of the leg from external to internal rotation without the assistance of anesthesia or manipulation. It is accomplished with the child in bed and with gradual surface traction applied to the extremity.

At the termination of the second position a careful examination is made of the per-articular structure of the hip joint to determine the period when motion may be permitted. Experience guides in the future care of the case but it is noted that muscle spasm usually disappears rather quickly in the favorable cases. In less favorable cases there remains an indefinite period of reflex muscle spasm and contraction that leads one to be more cautious in starting motion in the joint.

The third stage is devoted to motion in the favorable cases at the end of the sixth month. Freedom of motion is permitted as a therapeutic test while the child is still in bed and careful observations,

supplemented by x-ray examination, are made during this period. As the case progresses the child is encouraged to perform a series of passive and later active movements over a period of two weeks. If all is favorable the child is allowed out of bed and, carefully guarded by experienced nurses, it is placed in the upright position on its fully abducted legs and encouraged to take its first steps in walking. This is a very critical period and every movement of the child is watched with great care by the doctors and nurses. Further functional recovery is aided by the application of physiotherapeutic measures, consisting of dry surface heat and massage, and later a course of active exercises. These patients may be seen daily in the gymnasium with their legs in full abduction and internal rotation, learning new steps in walking with the aid of perambulators.

The children are always under the very watchful eye of Prof. Putti and his assistants, who are ever alert to detect unfavorable signs that might develop in the period of functional recovery. An event of great importance, which is constantly guarded against, is the occurrence of subluxation. This is very infrequent as the entire surgical and nursing staff are thoroughly familiar with the physical signs that precede it and are ever ready to apply the necessary measures to prevent it. The development of increasing muscle spasm, associated with slight flexion, adduction and internal rotation of the leg, is sufficient indication to discontinue motion and to place the child in bed with surface traction restored.

In a few cases the limited motion and muscular rigidity that is present when the cast is removed, will persist beyond the average period in spite of local treatments. In this instance the application of a hip spica to the sound side, will in most instances, hasten the functional recovery. The average case should be well along the road to functional recovery at the end of the ninth month, although patients

remain under very careful observation in the follow-up clinic for years.

*Operative Treatment:* While it is by far the least frequent method of treatment, nevertheless it is important to mention the surgical indications for open reduction as employed at Rizzoli. The statistics show that the number of open reductions over a period of twenty-nine years is slightly over 4 per cent of all cases.

Open surgical reduction is expressly performed for the reduction of the femoral head only after failure of manipulation. The technic of Prof. Putti for the open reduction is, I am sure, well known and needs no elucidation. It may be stated, however, that the period of immobilization is considerably reduced, the average being three months. The most favorable period for operative reduction is up to six years in the unilateral dislocations four years in the bilateral dislocations.

When an operation is performed for a recurrence of dislocation it is usually in two stages: first, the manipulative reduction followed by immobilization in plaster for a period of three months; secondly, the open approach with the formation of a shelf of bone curled down from the side of the ileum in close proximity with the femoral neck. This form of limited stabilization has been quite successful in the cases on which it has been tried.

When the favorable period of operation has passed difficulties arise that are often puzzling. The factors that lead to the determination of the proper procedure are not based solely on the anatomical displacement of the femoral head and its subsequent deformity, but rather on the individual peculiarities and environment of each case. In this instance the judgment of the experienced surgeon may not only be required, but may be sorely tried, to establish a satisfactory method of treatment.

In late cases in which a reduction has not been accomplished, and this group includes the neglected cases between the ages of fifteen to twenty years, it is the practice to do an open operation to stabilize

the hip, remove pain usually of an arthritic character, and to improve function without attempting a reduction. The one most frequently done is the Lorenz bifurcation operation. In some cases arthritic pain is present at an early date and in these it is necessary to adopt some surgical measure, even under the threat of possible ankylosis, in order to secure relief from pain. In very exceptional cases the measures used have even led to an arthroplasty.

There remains another group, that has passed the operative period, in which the dislocation persists and the disability is great. I have in mind the neglected cases of patients who have grown to full womanhood who sometimes come to the clinic for treatment. In this type one should have the courage and good judgment to follow a course of judicious neglect, for in the final analysis, there is little or nothing that can be done that would improve their condition.

A word may here be said of the cases grouped under the heading of subluxation. Such patients are usually very troublesome because of the constant pain, indefinitely localized, but nevertheless seriously interfering with the comforts and happiness of the patient and, to a lesser degree, the functional disability. They are very

trying, as the surgical indications are not clearly defined and the functional and anatomical disability of such a character, that one would hesitate at operative or manipulative treatment. Some success has been obtained with these with the limited stabilization of the shelf operation.

The published results of congenital dislocation of the hip from the Istituto Rizzoli are very well known and I am sure that many have had the pleasure of witnessing, at first hand, the remarkable accomplishments of Prof. Putti. His reports of success in over 90 per cent of unilateral and over 60 per cent bilateral cases are worthy of profound admiration.

His technic is perfection in the art of manipulative surgery. The number of cases treated and the equipment provided for their care is impressive. The skill and dexterity with which his manipulations are performed are a revelation. His logical and clear-cut conception of the entire course and progress of congenital dislocation of the hip and his successful efforts in personally arousing the enthusiasm of his co-workers, to establish the early diagnosis and treatment in this difficult and most interesting field of orthopedic surgery, are accomplishments at which we can truly marvel.

WILLIAM G. DORAN, M.D.



### THIRD INTERNATIONAL CONGRESS OF RADIOLOGY PARIS, JULY 27 TO 31, 1931

THE five United States Delegates to the Third International Congress of Radiology met in Detroit, July 23, 1930, for the purpose of discussing ways and means of distributing the limited number of scientific contributions to the Paris Congress.

It was unanimously decided that all applicants should mail data regarding their prospective contributions to the secretary Dr. Edwin C. Ernst, Beaumont Medical Building, St. Louis, Mo.

The scientific program of this Congress will be divided into six sections as follows:

1. Roentgen diagnosis.
2. Roentgen and Curie-therapy.
3. Radiology.
4. Radio-Physics.
5. Natural and Artificial Heliotherapy.
6. Medical electrology.

All requests for contributions must include the full title, name or names of the essayists, together with a brief abstract *not to exceed 400 words*.

The local committee of five will review and make the necessary recommendations to the international committee, but in addition, whenever it may be deemed expedient, the opinion of other radiologists and specialists will be invited in helping to pass judgment so that an impartial decision may be reached in the interests of the best possible representation from the United States.

President Antoine Beclere has informed your committee that each contribution will be limited to fifteen minutes maximum. Furthermore, should the communications submitted by the respective countries be too numerous that the international committee in Paris reserves the right to limit their number even though the local committee had accepted such contributions.

The Congress will hold its meetings in the Sorbonne. As to hotels, the Committee on Arrangement believes that many of the delegates will prefer to choose their own hotels, and so no special hotel has been designated as headquarters for the delegates. All physicians will be welcome at the Congress.

The delegation from the United States of America includes Dr. Albert Soiland, delegate from the American Medical Association, who is chairman of the committee for the United States, Dr. Douglas Quick, from the American Radium Society, Dr. George E. Pfahler, from the American Roentgen Ray Society, Dr. E. C. Ernst, from the Radiological Society of North America, and Dr. James T. Case, from the American College of Radiology.

JAMES T. CASE.



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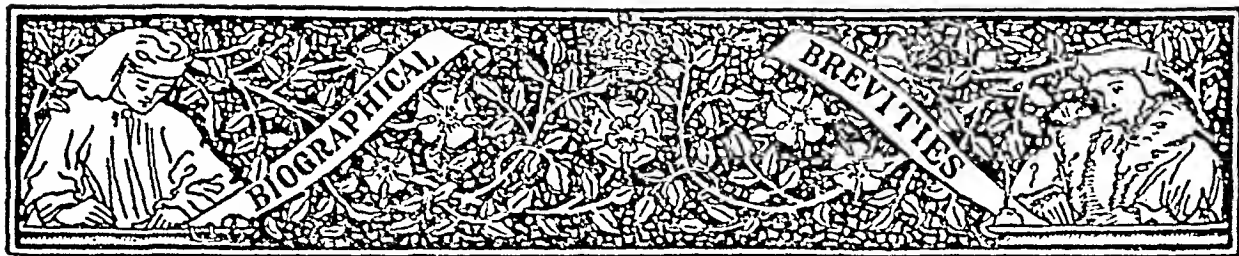




*John B. Murphy*

*Courtesy, Surgery, Gynecology and Obstetrics*

[1857-1916]



## "MURPHY BUTTON"

“AMONG those who knew him well he was admired and deeply respected rather than loved. Except to a very few he was not genial nor responsive in friendship. . . . Murphy was beyond question the greatest clinical teacher of his day, anyone who listened to him can never forget the experience.” These words are from the pen of Moynihan, the world-famous Leeds’ surgeon.

John Benjamin Murphy was born on December 21, 1857. He graduated at the age of twenty-two years from the Rush Medical College. He then interned at the Cook County Hospital. After less than two years spent as an interne he went into practice with Dr. Edward W. Lee. Two years later he went to Germany to further continue his studies. He remained on the Continent about a year and a half. He then returned to Chicago and resumed the practice of surgery.

His first appointment was to the surgical staff of the Cook County Hospital and the Alexian Brothers Hospital of Chicago. In 1905 he was appointed to the Chair of Surgery at Northwestern University. This he held until his death. Also, he taught surgery in the University of Illinois, and in Rush Medical College.

Murphy was a Regent and one of the founders of the American College of Surgeons.

He was a voluminous writer. It would be futile to attempt to list the papers and books and special chapters of which he was author.

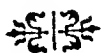
The diagnostician accepts as commonplace Murphy’s first percussion for diagnosis in kidney disorders, the hammer stroke percussion in gall-bladder disease, also his deep grip palpation in suspected gall-bladder pathology, the piano stroke percussion to detect free peritoneal fluid, and his comparative bimanual examination to determine various degrees of rigidity. Every Doctor of Medicine knows of the “Murphy Button” though he may never have seen one—and today the “Murphy drip” still enjoys a wide application in postoperative treatment.

Murphy was a brilliant teacher. He was a deft and skillful and resourceful surgeon. One criticism may be ventured. He did not train younger men to take up his work where he left off and become nearly as great as he.

Murphy’s honors were many. He received honorary degrees from the University of Notre Dame, the University of Illinois, and the University of Sheffield, England. He was one of the first to note and preach the need of making an early diagnosis in acute appendicitis and then resorting to an early operation. His field was the entire body but he did specially brilliant work on the gall bladder, intestinal tract, blood vessels, and bones and joints.

At the height of his fame and usefulness he died at the age of fifty-nine years on August 11, 1916.

T. S. W.







[From Fernelius' *Universa Medicina*, Geneva, 1679.]

# BOOKSHELF BROWSING

## FIFTIETH JUBILEE OF THE SOCIAL AND SCIENTIFIC ACTIVITY OF THE EMERITUS PROFESSOR OF SURGERY V. I. RAZUMOVSKY

N. N. NAZAROFF, M.D.\*

SARATOV, RUSSIA

MAY 25, 1930, scientific Russia, especially the medical profession, is uniting to celebrate the fiftieth anniversary of the medical and scientific work of the veritable patriarch of Russian surgery, Prof. V. I. Razumovsky, who was born in 1857 in a poor Russian village.

In 1880 Prof. Razumovsky was graduated from the medical school of Kazan University. In 1884 he was appointed assistant professor having completed a work on atrophic processes in the bones after nerve dissection; and in 1887, when he was thirty, he was offered the chair of surgery.

The first twenty-five years of Prof. Razumovsky's scientific activity were spent in Kazan University and when the scientific world in 1906 celebrated his twenty-fifth anniversary, the reports on his quarter of a century of work demonstrated the importance of his achievements.

At that time he had already created a school and many of his pupils are now distinguished scientific workers in Russia. Prof. Razumovsky's talented pupils, many now professors, have made important contributions to the surgery; they have written monographs on experimental sur-

gery which are considered complete scientific manuals of surgery (Profs. Tikhoff, Opokin, Bogoluboff and others) and they have written books which became the texts for the younger generations of Russian physicians. At the same time Prof. Razumovsky himself is an author of a great number of monographs and other works of classic perfection, such as for instance his work on the surgical treatment of Jackson epilepsy<sup>1</sup> (the use of electrodes for determination of the motor cortical centers Prof. Razumovsky first tried in 1894), on his method of suturing the bladder<sup>2</sup> and making temporary sutures,<sup>3</sup> his plastic operations on the bones<sup>4</sup> of the foot and his conservative operations on the testis,<sup>5</sup> all of which date from this period and are described in all manuals of surgery. He was the first to make observations on the operation for dissection of nerve roots behind Gasserov's ganglion in the neurology of nervus trigeminus.<sup>6</sup> A great achievement of Prof. V. I. Razumovsky at that period was his editorial work in *Russian Surgery* (7 volumes, 1902 to 1916), a voluminous publication to which Russian surgery and general science owe much for their growth. Even

\* Translated by Tatiana W. Boldyreff.

then invisible cords united thousands of physicians and surgical centers with one headquarters of which he was the inspiring

him as a prominent surgeon even in the early years of his clinical and scientific career. Later, the leading figure in Euro-



Prof. V. I. Razumovsky.

director. His fame as a most humane physician and most skilled of surgeons spread up and down the Volga and even beyond. Thousands of patients sought him to get cured of their ills and to receive valuable advice. Prof. V. I. Razumovsky was one of the first among the Russian surgeons to develop perfect asepsis. He reached a high degree of perfection in his surgical technic, operating upon all the organs of the human body. Even then he had a good scientific reputation in Western Europe. Prof. Billroth recognized

pean surgery at that time, Prof. Bergmann (Berlin), greeted Prof. Razumovsky on the day of this twenty-fifth anniversary with a telegram, recognizing his great contributions to science. Congresses of Russian surgeons elected Prof. Razumovsky their honorary chairman (Second and Third Congresses), as well as the general congresses of physicians in memory of N. I. Pigrogoff. Many scientific societies worked under Prof. Razumovsky's guidance and were flattered to have him their honorary chairman. Students looked

upon him as an eminent teacher and clinician, and, going away to remote parts of the country, these thousands of young physicians carried away in their hearts a bright image of him, of his teachings and of his motto: "Science is knowledge which endeavors to find the truth." Prof. Razumovsky kept up a close relation with Western Europe by making frequent trips to various foreign countries and through personal friendship with many prominent European surgeons. He gave preference to the clinics of Billroth, Albert, Bergmann and others. The best foreign periodicals have published many of Prof. Razumovsky's works.\*

In the second half of his fifty years of scientific work Prof. V. I. Razumovsky devoted most of his colossal energy, experience and knowledge to the organization of various scientific centers in the remote provinces of the country in accordance with his idea of "throwing scientific knowledge to the wide masses of population." Prof. Razumovsky undertook the problem of organizing a University in Saratov which he carried out to a successful end in 1909. As the President of Saratov University, a builder of it, the organizer of all the scientific life of that city, he gave much time, effort and energy to it. This school became the center of learning for a large region.

In 1914 the World War called on Prof. Razumovsky to supervise field surgery on the extensive Caucasian front. In this case, as ever, working with the ideals of Pirogoff, Prof. Razumovsky achieved a wonderful development in military sanitary work. The crippled and the wounded found in him the rare combination of vast knowledge and experience with love for his fellow sufferers, and he strove to alleviate their pains as much as was humanly possible. The war over, when cultural work was again made possible, Prof. Razumovsky was called upon to organize two more universities, one in Tiflis and one in Baku.

\* *Arch. f. klin. Chir., Russ. med. Rundschau* and others.

Among the peoples of the Caucasus the name of Prof. Razumovsky has entered oral tradition, for he has kindled in their hearts the sacred flame of knowledge. The first scientific works of these universities were dedicated to him and he is invited to all their academic fêtes as their "father."

In 1920 Prof. Razumovsky left the Caucasus, returning to Saratov, and resumed his clinical work as the Director of the Saratov Surgical Clinic. The school again produced under his guidance many a scientific worker. His pupils go out organizing surgical work among the vast masses of population and creating new surgical centers.

Prof. Razumovsky is at present especially interested in America because of her colossal progress in scientific surgery. He is very well familiar with the works of American surgeons. Dr. Senn was his friend and the two admired each other as scientific workers in the field of surgery. He follows up all the new tendencies in general scientific thought. He was ever attracted by the philosophical sciences and he is still now plunging into their depth. He has an excellent memory.

When he operates on a patient, Prof. Razumovsky's attitude is very kindly and his first thought is to be careful not to hurt the patient. His personality, marked with affability, sociability, kindness to his patients, makes him a general favorite.

His fiftieth anniversary finds him physically strong. Prof. Razumovsky's mode of living is well worthy of admiration and imitation. A profound understanding of the laws of physiology, the laws of life, is reflected in the wise simplicity of his environment, in the order of his day, in his habits and all his doings. He is an ardent advocate of physical culture and has developed his own system of physical exercises through which he goes daily without fail. We have no doubt that for many long years to come we shall see him strong and healthy in body and spirit. He is now seventy-three years old.

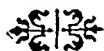
Prof. Razumovsky's attention as a scientist is now centered on the problems of lessening pain. He is at this moment gradually working out step by step this problem of lessening human suffering.

Prof. Razumovsky is an ornament to Russian surgery. And not of Russian surgery alone. He has been elected an honorary member of many foreign surgical societies. The Russian Surgical Society, at the Congress of 1929, offering a prize, in the name of Razumovsky, for the best work in general surgery, has decided to celebrate the anniversary of this venerable savant at the Moscow gathering in the spring of

1930, when they expect Prof. Razumovsky to give them an address on higher medical education in Russia.

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## BOOK REVIEWS

**MEDICAL LEADERS.** From Hippocrates to Osler. By Samuel W. Lambert, M.D., and George M. Goodwin, M.D. 349 pp., 32 illus., Indianapolis, Bobbs-Merrill Co., 1929.

This is in reality a "popular" history of medicine, arranged chronologically according to the reigns of the kings of science. The authors have done a good piece of work. It would be unfair to look upon this book in the same way as one does upon a Garrison or Sudhoff History. The intention is obviously to give a quick resume of the high spots of medical history and at the same time perhaps to stimulate interest in further reading. Both of these objects have been well accomplished and we hope that the book is having the widespread sale that it deserves.

**A PRACTICAL MEDICAL DICTIONARY.** By Thomas Lathrop Stedman, A.M., M.D. Ed. II, 1233 pp., illus., N. Y., William Wood & Co., 1930.

Stedman's Medical Dictionary, now in its eleventh edition, has always appeared to the reviewer as "the best" and the new edition lives up to its previous reputation. The absence of terms like *encephalography*, *ganglionectomy*, *neokinetic*, *urography* and others is a bit discouraging but perhaps there is a good reason for the omission. As *ventriculography* is to be found, perhaps the missing words will be included in the next edition. It is also disappointing to find that the reticulo-endothelial system must be looked for under "system" rather than under "r" as in other dictionaries. However, probably no one dictionary can be made to please everybody and undoubtedly the Editor, who writes a very interesting and aggressive Preface, has much better reasons for his action than the reviewer could possibly have for criticism. Therefore Stedman continues to be our favorite dictionary.

**ROSE AND CARLESS' MANUAL OF SURGERY** for Students and Practitioners. Ed. by Cecil P. G. Wakeley, F.R.C.S., F.R.S., and John B. Hunter, M.C., F.R.C.S. Ed. 13, 1631 pps., 707 illus., 19 col. pl. N. Y., William Wood & Co., 1930.

It was a peculiar sensation to pick up the thirteenth edition of "Rose and Carless'

Manual of Surgery." "Good Heavens," said we, "how stout our old friend is getting to be." But after some time spent in renewing old acquaintanceship the fact has been revealed that our friend has indeed matured with age and it is amusing to read the first lines of Mr. Carless' Foreword in which he says: "It is with very mixed feelings that I sit down to write a Foreword to this the thirteenth edition of 'Rose and Carless,' which for me is in reality a valedictory message. I am proud and happy to have been permitted to send out twelve editions during the past thirty-two years, and throughout this long period the book has retained its popularity, and has, I trust, fulfilled the purpose with which it was originally conceived—viz., to serve as a textbook for students preparing for their examinations, and also to be of use to practitioners when faced with surgical problems in after-life." Mr. Rose has already departed and now Mr. Carless speaks of his valedictory message. Messrs. Wakeley and Hunter now usurp the places of honor on the title page and as these gentlemen are fortunate in their predecessors as editors and authors, so are Messrs. Rose and Carless fortunate in their successors. A careful perusal of the book leaves us with a feeling that the thirteenth edition is the best yet and we wish and prophesy for the new "Wakeley and Hunter" the same success during the next three decades that the "Rose and Carless" has had in the last thirty years.

**DIE CHIRURGIE.** Ed. by Prof. Dr. M. Kirschner and Prof. Dr. O. Nordmann. Band II, 2. Teil. **DIE OPERATIONEN AN DEN KNOCHEN UND GELENKEN.** By Dr. A. Winkelbauer. 199 pp., 97 illus. & col. pl. Berlin, Urban & Schwarzenberg, 1930.

This twenty-ninth number of *Die Chirurgie* is quite on a par with the previous numbers. It covers thoroughly and completely the operations on the bones and joints, with, as is usual in this work, a complete bibliography. Each number as it is received makes one more and more impatient to have the complete work at hand for reference.

**DISEASES OF THE SKIN.** A Text-Book for Practitioners and Students. By George Clinton Andrews, A.B., M.D. 1091 pp., 988 illus., Phila., W. B. Saunders Co., 1930.

Here is a thoroughly modern and up-to-date book on the diseases of the skin, written by a man with experience and literary ability. There are almost a thousand illustrations, all of them carefully selected. The sections on roentgen and radium treatment and surgical diathermy are terse and yet complete. All in all this is as good a reference book on dermatology as we have seen in a long time and one which every surgeon will be the better for having—if he uses it.

REMINISCENCES OF GEORGE MARTIN KOBER, M.D., LL.D. Vol. 1. Publ. under auspices of Kober Foundation, Georgetown Univ., 429 illus., 1930.

Dr. Kober's "Reminiscences" are more than a biography. With active and thrilling years to look back upon, he minimizes his own activities and uses them mainly as a peg on which to hang the story of the growth of medicine and medical men during his lifetime. His account of the Western Indians and their medical practices will, in itself, make this a work of reference.

It is tempting to give a long resume of this volume, but suffice it to say that here is a work from the reading of which every medical man will derive untold pleasure. It is much more fascinating than the average fiction of today, and than most of the iconoclastic biographies so popular at present. No physician will put this volume down without feeling a greater respect than ever for the good old-fashioned "general practitioner."

THE PATHOLOGY OF DIABETES MELLITUS. By Shields Warren, M.D. Foreword by Elliott P. Joslin, M.D. 212 pp., 83 eng., 2 col. pl., Phila., Lea & Febiger, 1930.

The following paragraphs from Dr. Joslin's Preface present the picture of this book better than anything the reviewer might say:

A Monograph upon the Pathology of Diabetes does not appear redolent of hope, but as I have watched sentences, paragraphs and ideas fresh results of hard and thoughtful work go into this volume, I have seen hope creeping in too, and at length have realized that this is a pathology of and for the living almost as much as of the dead. The present diabetic is half and half a surgical and a medical diabetic, and this has afforded Dr. Warren an opportunity to have nearly as many biopsies as autopsies upon which to form his conclusions and he has made of most of it. . . . Some day I wish all who read these pages could visit the modern operating room Dr. Warren has for his patients, for a Pathologist

is a Doctor first of all, and there read the motto on the wall—*Mortui vivos docent*—because then you would come away not dreading to return.

It might be added that the book is well written, short and to the point, and no surgeon ought begrudge it the short time necessary for a reading.

HISTOLOGY FOR MEDICAL STUDENTS. By H. Hartridge, M.D., SC.D., M.R.C.P., F.R.S. 412 pp., 512 illus. & col. pl., London, Oxford Univ. Press, 1930.

The authors say that "In writing this book we have attempted to describe the tissues of the body in such a way that the student will be given an adequate knowledge of the subject without being burdened with details which only specialists would require." For this very reason the book has the defects of its qualities. Its outstanding feature is the fact that it has nearly 500 colored figures which are far above the average in quality. These at least will be useful to the physician and surgeon. The text, however, is too elementary to be of practical value to anyone but the student. As is usual with Oxford publications the book-making leaves nothing to be desired.

APHASIA IN CHILDREN. By Alex. W. G. Ewing, M.A., PH.D. Introduction by E. D. Adrina, M.D., F.R.C.P., F.R.S. 163 pp., diagrams, London, Oxford Univ. Press, 1930.

An "Explanatory Note" states that "This book is a brief account of the methods by which it was discovered that of ten congenitally 'aphasic' boys and girls, six suffered from a condition of partial deafness hitherto unknown and unstudied. Prior to this research they had been variously classed as aphasic, as totally deaf, or as having normal hearing and being totally or almost totally dumb for some cause unknown. The symptoms which led to such varying conclusions are here traced to a condition of normal or relatively normal hearing for a certain range of low tones, associated with marked deafness to high tones." A most interesting thesis and indispensable to anyone interested in the subject.

A TREATISE ON ORTHOPAEDIC SURGERY. By Royal Whitman, M.D., M.R.C.S., F.A.C.S. Ed. 9, 1085 pp., 981 eng. Phila., Lea & Febiger, 1930.

A new edition of Whitman's classic "Treatise on Orthopaedic Surgery" is always welcome and this ninth edition is quite on a par with its predecessors. This work may be considered as representing the latest teachings on the subject, though it is disappointing not to find Boehler's fracture treatment even mentioned.

**MINOR SURGERY AND BANDAGING.** For the Use of House Surgeons, Dressers, and Junior Practitioners. By Gwynne Williams, M.S., F.R.C.S. Ed. 20, 453 pp., 262 illus., Phila., F. A. Davis Co., 1930.

This book, now in its twentieth edition, was first published in 1861. While it has been regularly "revised and brought up-to-date" evidences of mid-nineteenth century writing still prevail. Much space is given to elementary platitudes, such as: "The greatest care must be taken to prevent the formation of bed sores." On the other hand, the subject of pyelography is dismissed in ten lines! As is inevitable in books intended to be both elementary and advanced, the work falls between two stools. The publishers' work has been well done and we have a handy volume of almost 500 pages, attractively bound in flexible leatherette with over 250 illustrations.

**OBSTETRICS.** A Textbook for the Use of Students and Practitioners. By J. Whitridge Williams. Ed. 6, 1175 pp., 17 pl., 730 illus. N. Y., D. Appleton & Co., 1930.

Williams' "Obstetrics" now appears in the "sixth revised edition, entirely reset." As in

the previous editions the work is particularly strong in Pathology and remains, as before, one of the best American texts on the subject.

**HANDBOOK OF ANATOMY.** Being a Complete Compend of Anatomy Including the Anatomy of the Viscera, a Section on Surgical Anatomy, a Chapter on Dental Anatomy, Numerous Tables, and Adopting the Newer Nomenclature Designated the Basle Nomenclature, Commonly Called BNA. By James K. Young, M.D., F.A.C.S. Ed. 7, 471 pp., 154 eng., some col. Phila., F. A. Davis Co., 1930.

The seventh edition of the late Dr. Young's Handbook of Anatomy has been revised by Dr. Miller of the Jefferson Medical College, Philadelphia. The Basle Nomenclature is used consistently in text, plates and index. The book retains its place as one of the best compends of anatomy for the use of the medical student.

**ELEMENTARY ZOOLOGY FOR MEDICAL STUDENTS.** By L. A. Borradaile, Sc.D. Ed. 2, 405 pp., 251 illus., London, Oxford Univ. Press, 1930.

In the second edition, according to the preface, "accounts of the Mosquito, the House-fly, and the Tapeworm have been inserted, and some minor additions and alterations have been made." The book should have a definite place in the library of the medical student and it can be used to advantage for quick reference by the general practitioner.



A CLINICAL STUDY OF THE  
ABDOMINAL CAVITY AND PERITONEUM

EDWARD M. LIVINGSTON, M.D.

PUBLISHED SERIALY IN

*The American Journal of Surgery*

ELEVENTH INSTALLMENT

SECTION II. THE GASTROINTESTINAL TRACT (CONTINUED)

[In the following pages the Journal page number will be found at the bottom of the page.]



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# A CLINICAL STUDY OF THE ABDOMINAL CAVITY AND PERITONEUM\*

## SECTION II. THE GASTROINTESTINAL TRACT (*Continued*)

### C. THE ABDOMINAL VASCULAR SYSTEM

2. SURGICAL MANAGEMENT OF ABDOMINAL BLOOD VESSELS  
(*Cont.*) *Intestinal Resections:* Methods for the control of blood vessels during intestinal resections depend upon the length and location of the bowel segments to be removed. If the portion for resection is short and consists of jejunum or ileum it proves sufficient simply to sever the mesentery from the intestinal wall without removing a corresponding mesenteric wedge. The following suggested technic (see Fig. 171) includes several important considerations: (a) Cut the bowel wall obliquely, removing a greater length of the free border than of the mesenteric border. The small bowel receives an arterial supply in a series of vascular loops or arcades which radiate from a center; to cut at right angles to the axis of the intestine leaves poorly nourished areas at the free borders of the parts which remain. (b) Use interlocking ligatures upon the mesentery. When this is done no small vessel can escape and ligatures do not slip. (c) At the mesenteric border of each extreme cut-end of bowel take a stitch which includes the serous and muscular coats of the intestine and a portion of adjacent mesentery. This closes the raw or extraperitoneal area between the mesenteric leaves, catches the terminal artery as it enters the zone of resection, and prevents further tearing of mesentery from bowel wall. (d) Peritonealize the mesenteric stump. To cover all raw surfaces prevents adhesions and further ensures

\* Previous installments of this book appeared as follows: Vol. viii: January issue, p. 193; February issue, p. 459; March issue, p. 693; April issue, p. 911; May issue, p. 1109; June issue, p. 1325. Vol. ix: July issue, p. 157; August issue, p. 365; September issue, p. 581; Vol. x: October issue, p. 419.

control of severed arterial branches. Nearby vessels must not be kinked or damaged during this process of peritonealizing the cut edge of the mesentery.

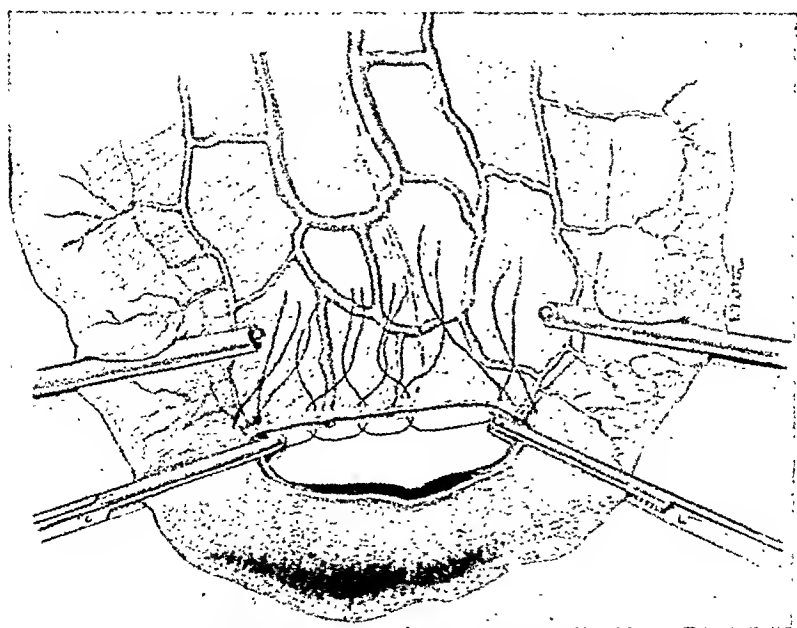


FIG. 171. Resection of short loop of ileum.

Note the vascular arcades, the interlocking mesenteric sutures (untied), and the "end-stitches" which are so placed as to grasp the outer coats of the intestinal walls. Observe also that the proximal clamp of each pair has rubber-protected blades. The distance between the clamps makes it possible to perform an end-to-end anastomosis before the proximal clamps are removed, hence without leakage of enteral content.

When the short segment to be removed is within the descending colon rather than within jejunum or ileum considerable care is needed in order to avoid injury to the vessel which runs parallel to the colic wall. Arteries of the descending colon do not form arcades but travel as relatively straight trunks. It is a basic rule regarding the intestinal blood supply that in portions of the tract which are fixed or devoid of mesentery the main arterial trunk travels in close proximity to the intestinal wall; while in portions of tract which are freely movable (supplied with mesenteries) the chief vessel is located at a considerable distance from the bowel. Thus in duodenum, ascending colon, descending colon, and rectum, main arteries and intestinal walls are in close proximity; but

they are located at a distance from one another in jejunum, ileum, transverse colon, and sigmoid colon. This rule applies even to the stomach, where the vessels of the lesser curvature

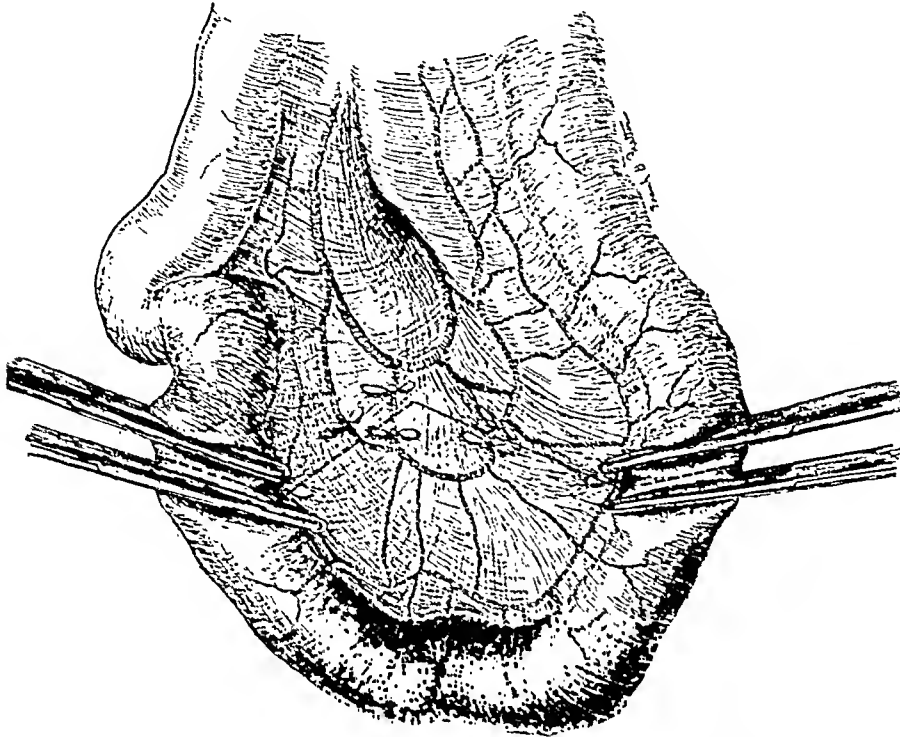


FIG. 172. Resection of a longer segment of intestine.

The primary vascular loop remains uninjured. The vessels are doubly ligated and severed along the sides of the mesenteric wedge. The bowel itself is cut obliquely, removing a greater length of free border than of mesenteric border. The clamps here illustrated all are of a crushing type and the distance between those of each pair is short. With this arrangement of clamps the intestinal resection is followed by inversion of the free ends of bowel and an anastomosis of a side-to-side variety.

(relatively fixed) lie close to the viscous, while the arteries along the greater curvature (movable and distensible) travel at a greater distance from stomach. Obviously, then, with reference to intestinal resections the more fixed the segment to be removed the greater the danger of vascular injury.

When the segment of intestine to be resected is long, a wedged, or v-shaped portion of mesentery is also cut away (Fig. 172). (a) At the point or apex of the wedge doubly ligate the branch or branches passing to the bowel from the primary arterial arcade. (b) Ligate proximally along the proposed wings or sides of the wedge all incoming arteries and arterioles.

(c) Place the two end-sutures at the extremities of remaining gut, in order to close the extraperitoneal space between the mesenteric leaves and to prevent separation of bowel and mesentery beyond the site of resection. (d) Cut the bowel obliquely on the line of the proposed mesenteric wedge. (e) Suture or peritonealize the mesenteric stump. When the v is narrow the mesenteric space may be closed by sutures; but when the stump of mesentery is of considerable length (resection of many inches of intestine) it may prove advisable to employ a free omental graft to cover the raw surface.

As shown in the accompanying figures it is the position of the clamps upon the bowel which determines the exact points at which vessels are to be tied. When the subsequent anastomosis is to be of a side-to-side variety each pair of clamps is closely approximated and is of the crushing type.<sup>244</sup> The cut ends of the intestine are inverted and the lateral anastomosis made at any point desired. But when the union of the severed extremities of bowel is to be of an end-to-end variety each pair of intestinal clamps consists of one crushing clamp and one with rubber-protected blades; for here it is essential that no remaining bowel be injured. With an end-to-end anastomosis, also, the protected clamps and the crushing clamps are kept several centimeters apart in order that, after the resection, the anastomosis may be completed without removal of the rubber protected blades; and these are removed only after the continuity of the bowel has been reestablished.

*Gastroenterostomy:* In performing a posterior gastroenterostomy the posterior gastric wall is displaced downward into the infracolic division of the peritoneal cavity through a rent created for this purpose within the transverse mesocolon. A non-vascular area below the arch of the middle colic artery is selected in making this opening through the mesocolon. But seldom is an important vessel injured. Minute vascular twigs are readily controlled by ligatures or suture-ligatures. Should the middle colic artery inadvertently be damaged (injury of this vessel is more likely in operations upon the transverse

colon itself), it is essential that both ends of the severed trunk be ligated. The blood supply of the transverse colon represents the longest and largest arterial anastomosis within the gastrointestinal tract. It has been referred to as the *anastomotica magna* and represents the site of union of the functional midgut with the functional hindgut (anastomosis of middle colic artery derived from the superior mesenteric artery with the left colic artery derived from the inferior mesenteric artery). Since the trunk is not an end-vessel both extremities must surely be tied; for although the bleeding may appear to arise from but one end, the opposite cut-end may subsequently open widely with a resulting severe internal hemorrhage.

When the gastroenterostomy is made with the aid of clamps bleeding from the stomach and jejunum is fully controlled until the hemostatic sutures have been placed. At times the disconcerting circumstance arises of having completed the union of stomach and bowel only to find upon removal of the clamps that blood wells up from between the sutures at several points, appearing at the surface and also distending the jejunum. This means that the sutures have been poorly placed, usually that the inner rows of running stitches have not been drawn sufficiently tight; or that as they were passed, one of the layers of the viscera, at some point, was not included.<sup>245</sup> Rarely, the suturing is not at fault but the bleeding occurs from the site from which clamps were removed. Also rarely, fatal postoperative bleeding has been proved to arise from a site at which a sharp toothed forceps had been applied to hold muscularis and mucosa together before sutures were taken, the forceps' grasp being beyond the tissues included in subsequent stitches. When bleeding, whatever the cause, is detected after the anastomosis has been completed, it must be fully controlled. As a rule a few interrupted simple or mattress stitches accomplish the desired result. These may, if necessary, include all coats of intestine or stomach. Because of the danger of postoperative bleeding many surgeons have abandoned the use of clamps during gastrojejunostomies. When

no clamps are used all bleeding points are promptly recognized and easily and surely controlled. It is often possible to doubly clamp and ligate the larger vessels before these are severed.

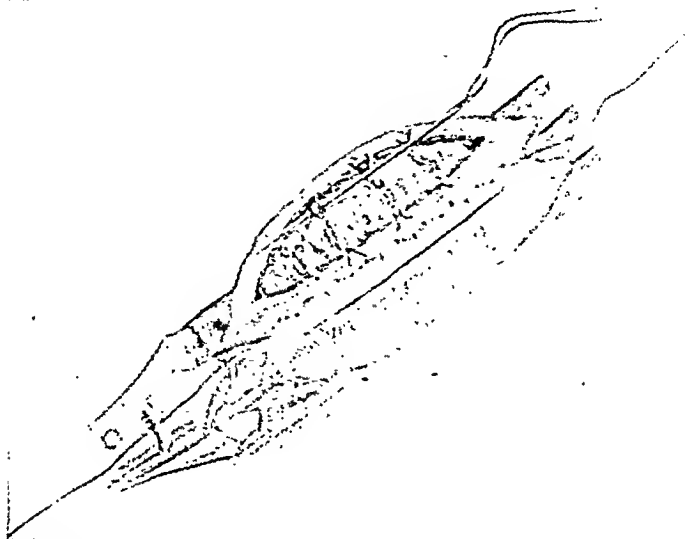


FIG. 173. Ligating vessels of the submucosa before they have been severed. (From Printy.)

For when the serosa and muscularis alone are cut the mucous membrane pouts outward carrying with it the vessels which traverse the submucosa, thus rendering them salient and subject to easy control (Fig. 173).

Just as an arterial anastomosis marks the junction of midgut and hindgut (*anastomotica magna*) so an anastomosis of vessels exists at the junction of midgut with foregut. The loop of duodenum with its contained pancreatic head is supplied in part from the celiac axis (superior pancreaticoduodenal artery which arises from the gastroduodenal artery, which in turn springs from the hepatic trunk of the celiac axis) and in part from the superior mesenteric artery (inferior pancreaticoduodenal artery, which represents the first or uppermost branch of the superior mesenteric trunk). This distribution of the three great gastrointestinal vessels to the functional thirds of the gastrointestinal tract makes it easy

for the surgeon to recall exactly the portion of tract supplied by each; the celiac axis being distributed as low as the mid-duodenum, the superior mesenteric artery supplying all intervening intestine to the level of the distal part of the transverse colon, and the inferior mesenteric artery supplying the remainder of the tract except for the perianal portion which receives the inferior hemorrhoidal branch of the hypogastric artery (o. r. internal iliac).

*Gastric Resections:* Additional illustrations of the rich nature of the arterial anastomoses along the gastrointestinal tract are furnished by the vascular arches which traverse the gastric curvatures. Although these vessels are relatively small, easily accessible and hence readily controllable, it is of importance that each side of any point of severance should be securely ligated. The rich blood supply of the stomach and its essential lack of end-vessels allow the surgeon to make ligations largely to suit his own convenience without fearing subsequent necrosis of gastric wall. Spontaneous gastric bleeding, when copious, usually originates along the lesser curvature where the arteries (right and left gastric) travel in close proximity to the viscus.<sup>246</sup> The arteries along the greater curvature (right and left gastroepiploics), traveling well away from gastric wall, seldom rupture or become eroded into the stomach. Copious hematemesis not infrequently is due to erosion of the splenic artery or a pancreatic vessel.<sup>247</sup> This occurs where the posterior gastric wall has become adherent to the pancreas and posterior abdominal wall, obliterating the omental bursa (penetrating ulcer; carcinoma). Hematemesis from splenic tumors has been accounted for by the fact that the vasa brevia supplying the gastric fundus arise from the splenic artery.<sup>248</sup> In performing a sleeve resection of the stomach or a subtotal gastrectomy the arteries which almost surely must be dealt with are the right and left gastrics, the right and left gastroepiploics, and at times the gastroduodenal artery or the vasa brevia. A method for ligating the left gastric artery within the left gastropancreatic fold



and before it has reached the lesser curvature has already been illustrated (Fig. 174). In making a small v-resection along the lesser curvature it may prove feasible to strip the



FIG. 174. Ligation of left gastric artery during gastrectomy.

The vessel has been doubly ligated as it approaches the lesser curvature within the left gastropancreatic fold of peritoneum. The gastroduodenal artery is indicated in the vicinity of the closed duodenum at the right side as it descends from its source of origin, i.e. the hepatic artery, in the pancreaticoduodenal sulcus. The hepatogastric and gastrocolic ligaments have been severed and the omental bursa (lesser sac) thus opened. The transverse colon and mesocolon overlie the general mass of small intestine (jejunum). (From Taylor's Operative Surgery, Wood.)

lesser omentum (ligamentum hepatogastricum) from the lesser curvature without disturbing or ligating the main anastomotic arch (Fig. 175).<sup>249</sup>

*Internal Hernias:* The foregoing review of the surgical management of abdominal vessels is not intended as a study of operative technic but rather as a means for focusing upon individual minute and practical details regarding the distribution of gastrointestinal arteries and veins. And the

present study of retroperitoneal hernias, similarly, has to do with their relation to the gastrointestinal blood supply. These hernias will again be considered and with greater detail in

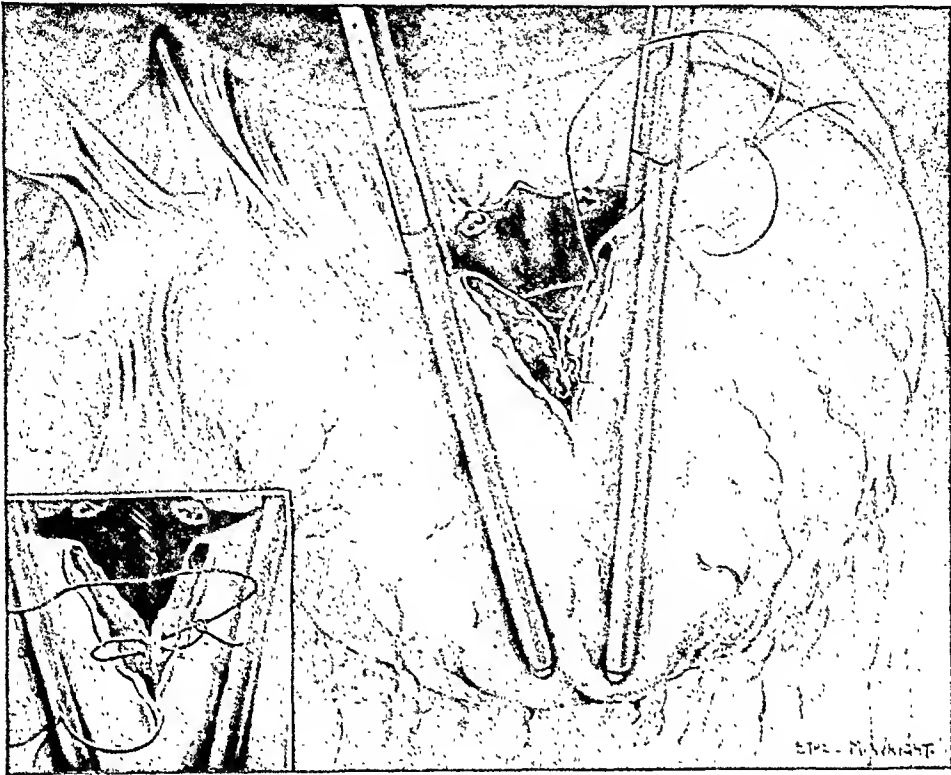


FIG. 175. Wedge or v-resection of lesser curvature.

The lesser omentum (lig. hepatogastricum) can sometimes be dissected from the lesser curvature without severing the main arterial arch. When, however, the artery along the curvature is severed it must, as illustrated, be ligated at both extremities. (From Moynihan's Abdominal Operations, Saunders.)

the section devoted to the peritoneal membrane and its reflections.

While a hernia is the protrusion of an organ, or the part of an organ, or other structure, through the wall of the cavity normally containing it, the term internal hernia is somewhat loosely applied to the protrusion of an organ or other structure through any aperture within the abdomen, for example a mesenteric slit or tear. But for the present purpose the term internal hernia will be used as synonymous with retroperitoneal hernia; namely, the engagement in a normal peritoneal fossa or in the foramen of Winslow of some portion of intestine.

Such hernias are of four chief anatomical varieties: (1) hernia into foramen of Winslow, (2) hernia into a fossa about the terminal duodenum, (3) pericecal hernia, (4) intersigmoid hernia. More important of subdivisions are mentioned later.<sup>250</sup>

A major vessel is located in one of the margins of the hernial ring at each of these sites of retroperitoneal hernia formation. This presents the problem, during reduction of the mass and the repair of the enlarged ring, of avoiding injury to large vascular trunks. Sharp dissection proves dangerous even under full vision. And although the surgeon has familiarized himself with normal anatomical arrangements at each of these regions the distortion produced by the mass is likely to prove confusing. When the intestine cannot be withdrawn from the ring by simple traction, due to trapped gas and enteral contents within the mass, it proves an excellent expedient to drain or aspirate the loop leading to the hernia. This collapses the bowel and partially empties the trapped loops, rendering reduction more easy (see p. 309).

There is no better illustration of the necessity for preparing at times of leisure for unexpected operative procedures, through directing attention to anatomical arrangements, than is afforded by the subject of internal hernias. These hernias are so seldom diagnosed before operation that the surgeon is precipitated most suddenly into the necessity for managing a specific case. The rarity of retroperitoneal hernias makes it quite certain that he has never before been confronted by an identical situation, hence must rely upon inherent knowledge rather than upon experience. Herniation below the mesentery of the sigmoid colon, for example, has been recorded in the literature but nine times,<sup>251</sup> for this is the rarest of all hernias. Few examples have been described of herniation into the fossae about the cecum; and of the more common involvement of the fossae about the duodenojejunal junction but approximately 100 authentic cases have been reported with less than a score of successful operations.<sup>252</sup>

The portal vein, hepatic artery and common bile duct are the important tubular structures found in close relation to the foramen of Winslow (Fig. 176A). The hernial mass is within the lesser sac of the peritoneum (retrogastric bursa). The contents are usually colon, cecum, omentum, or small bowel. Some congenital abnormality such as an altered form or size (great enlargement) of the aperture itself or an increase in length of the mesentery is necessary for the occurrence of this type of hernia.

Near the duodenojejunal angle are the inferior mesenteric vein, a branch of the left colic artery, and the superior mesenteric artery and vein (Fig. 176B). Hernias in this region are termed "right duodenal" or "left duodenal" according to the side of the duodenojejunal junction to which the ring is found and to which the hernial mass develops. The left variety is far more common. The first hernia of this type was described by Treitz;<sup>253</sup> hence, although at least ten different fossae or subdivisions of fossae about the terminal duodenum have been described,<sup>254</sup> any hernia in the region is referred to by some as a hernia of Treitz.

With left duodenal hernias the orifice is directed downward and to the right (Fig. 176B) while the mass passes upward to the left of the vertebral column; it lies upon the left psoas muscle between the kidney below and the pancreas above; as it continues to grow the mass may extend either upward or downward. But the important vascular portion of the orifice is located at the upper and left part of the ring, where the inferior mesenteric vein and the superior colic branch of the left colic artery arch over the left border of the terminal duodenum. This vascular arcade is known as the arch of Treitz.<sup>255</sup> The fossa into which left duodenal hernias almost invariably pass is the fossa of Landzert.

The important vessel in relation to right duodenal hernias is the superior mesenteric artery. The orifice of a right duodenal hernia points upward and to the left; while the pouch itself passes downward and to the right. The intestines involved

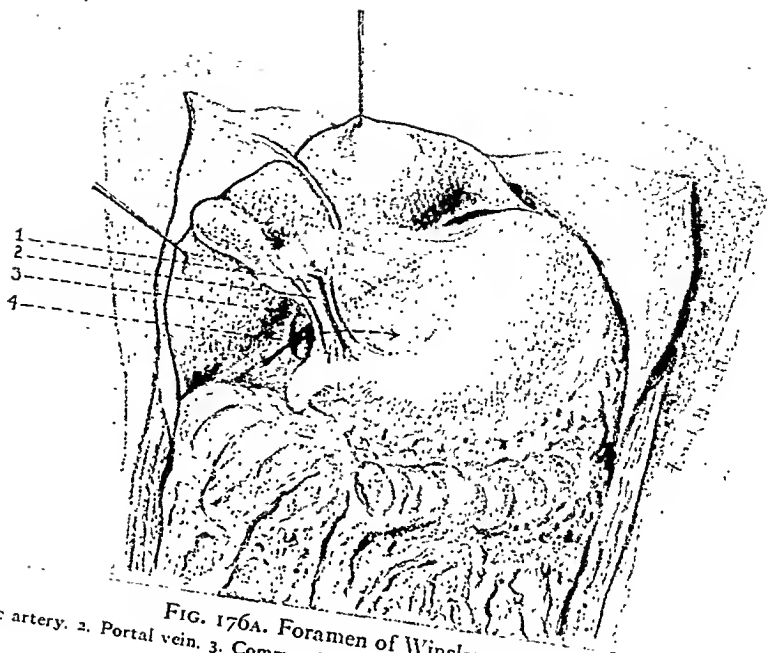


FIG. 176A. Foramen of Winslow.  
1. Hepatic artery. 2. Portal vein. 3. Common bile duct. 4. Inferior vena cava.

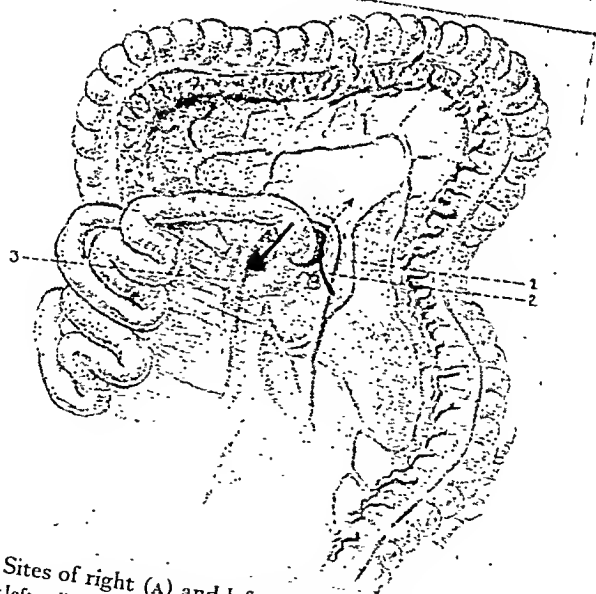


FIG. 176B. Sites of right (A) and left (B) paraduodenal herniation.  
1. Superior branch or left colic artery. 2. Inferior mesenteric vein. 3. Superior mesenteric artery and vein.

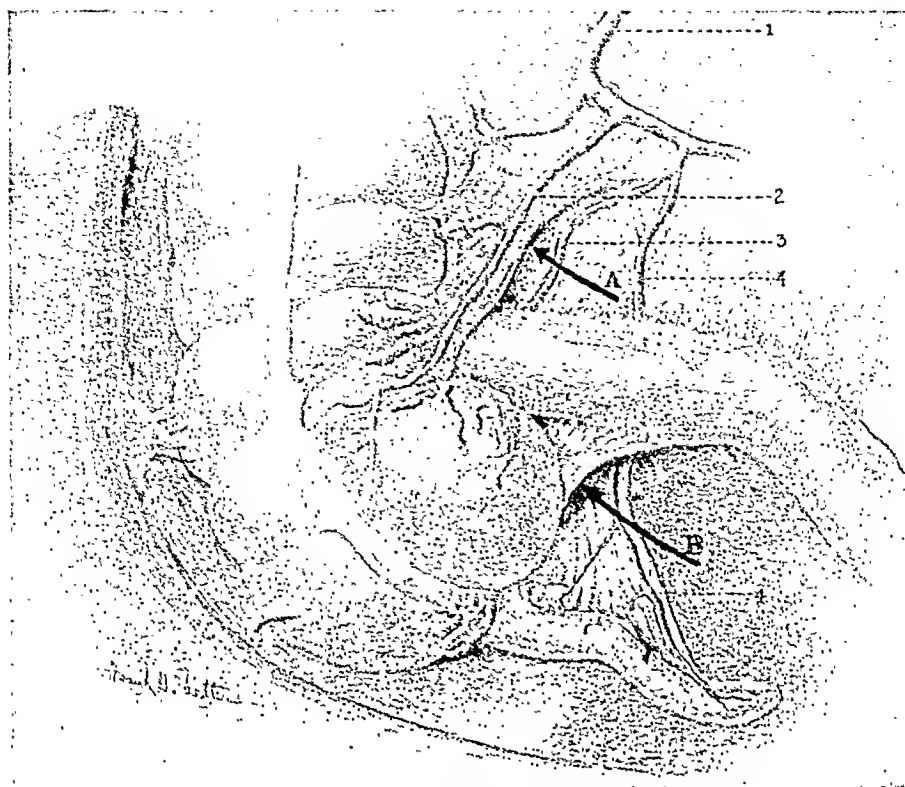


FIG. 176c. Superior (A) and inferior (B) ileocecal fossae.

1. Ileocolic artery. 2. Anterior cecal artery. 3. Posterior cecal artery. 4. Appendicular artery.

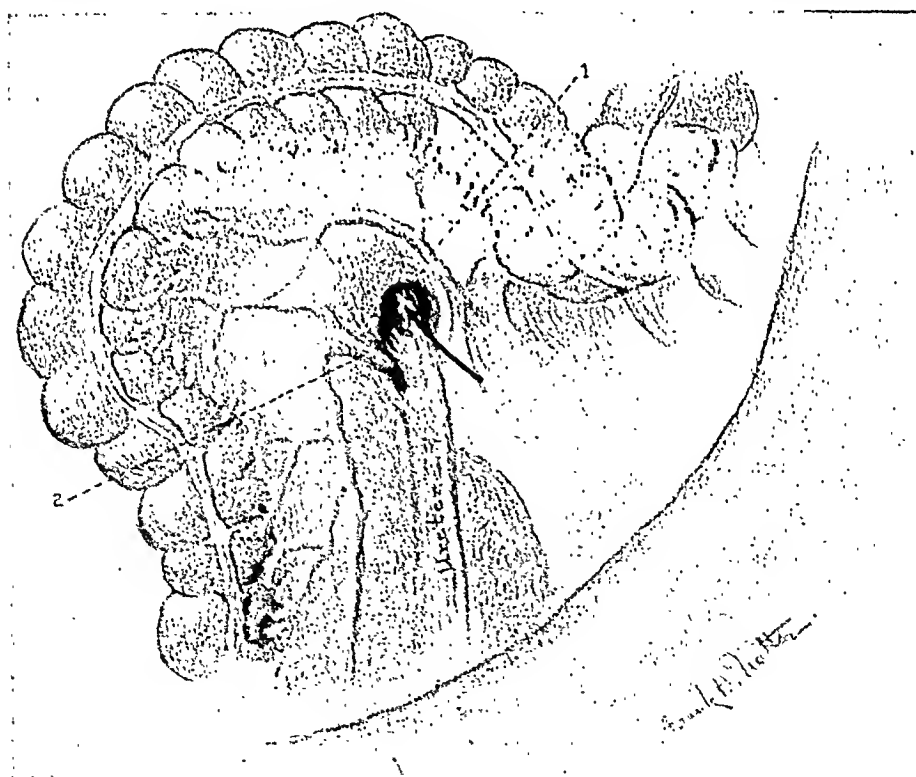


FIG. 176d. Intersigmoid fossa.

1. Sigmoid artery. 2. Superior hemorrhoidal artery.

FIG. 176. Relations of large vessels to sites of internal hernia formation.

[485]

in the hernia slide below the root of the mesentery of the proximal jejunum, i.e., they pass into the fossa of Waldeyer. The mass, then, lies below the terminal duodenum to the right of the duodenojejunal junction. Behind are the lumbar vertebrae while, in front, is the root of the mesentery with its vessels. To cut the anterior margin of a right duodenal hernia quite certainly means damage to the superior mesenteric artery or vein. As previously discussed, ligation of this artery leads to gangrene of bowel from duodenum to transverse colon.

With pericecal hernias (Fig. 176C) the sac is gradually forced upward behind the ascending colon between the two layers of the mesocolon. The sac itself is composed of the anterior layer of mesocolic peritoneum which has been forced through an aperture at the ileocecal region. The hernial ring may be situated above the ileum (ileocolic variety), below the ileum (ileocecal variety), or below the cecum (subcecal variety). In the common variety (ileocolic) of these rare hernias the upper and medial margins of the orifice contain the colic branch of the ileocolic artery. The appendicular, anterior cecal, and posterior cecal arteries, though smaller trunks, must also be dealt with.

The intersigmoid fossa lies on the lower or left surface of the mesosigmoid. Its concavity is directed downward (Fig. 176D). Its orifice readily admits the fingertip. The hernia itself passes upward near the inner margin of the psoas magnus muscle and directly in front of the bifurcation of the common iliac artery. Injury, in the anterior margin of the orifice, to the inferior mesenteric or superior hemorrhoidal vessels must be avoided; also of the sigmoid artery which traverses one orifice of the fossa.

To summarize: in all internal hernias great vessels form parts of the arch of the hernial orifice. This necessitates great care upon the part of the surgeon as he attempts to reduce the contents of the hernia or to repair the enlarged orifice, that irreparable damage be avoided.

*Control of Vessels of Spleen:* Study of the arrangement of the splenic vessels serves admirably to focus attention upon anatomical details relative to the region. In performing a

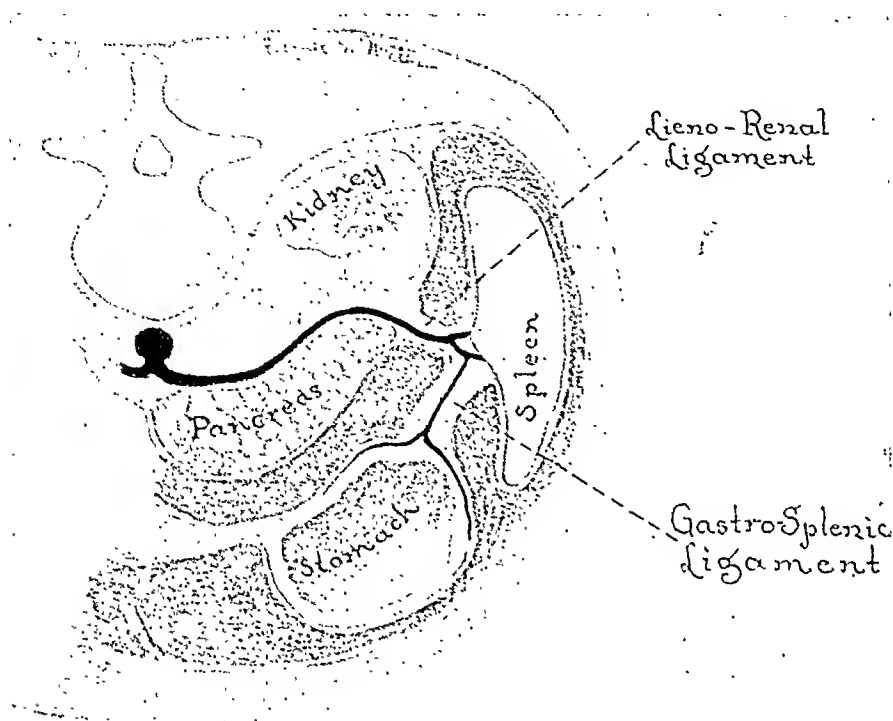


FIG. 177. Ligaments and vessels of the spleen, showing gastrosplenic ligament with the vasa brevia and the lienorenal ligament with splenic artery. (After Testut.)

splenectomy it is possible to ligate the splenic pedicle en masse when the organ is mobile; but when the organ is fixed by adhesions the vessels (splenic arteries and veins) must be tied separately if injury to the tail of the pancreas is to be avoided.<sup>256</sup> Ligation en masse is accomplished as follows: deliver the organ from the abdomen. Carefully pass a ligature carrier or clamp between two vessels within the pedicle. Draw a long, stout, ligature through the space created; cut the ligature creating two strands; interlock the two halves of the ligature; tie each about its half of the splenic pedicle. Now apply a clamp distal to these ligatures and divide pedicle between clamp and ligatures. Re-ligate entire stump for safety. During the maneuvers strong traction on the pedicle must be avoided



since the veins are very thin-walled. Fatal hemorrhages have occurred during operations in which the veins were torn. The pedicle consists solely of vessels traversing peritoneal folds, namely the gastrosplenic ligament and the splenorenal ligament (Fig. 177). With a relatively small spleen and no adhesions the splenectomy may not be difficult.

But in the presence of adhesions and with a very large organ the operation may prove extremely hazardous or even present problems which are insurmountable. The vessels must be separately ligated. When the organ cannot be wholly or partially removed ligation of the splenic artery may still be indicated. Necrosis, it has been shown, does not occur when the artery, but not the veins, is ligated; and after ligation atrophy of the organ tends to occur promptly. The splenic vessels together with the tail of the pancreas approach the pedicle from behind the posterior peritoneal wall of the lesser omentum (retrogastric space). They are reached by way of the gastrosplenic ligament, the gastrocolic ligament, the lesser omentum (hepatogastric ligament) or even from below upward by way of the transverse mesocolon. The surgeon, having entered the lesser sac by whatever route, picks up and incises the peritoneum forming the posterior wall and overlying the pancreatic tail and splenic vessels, thus exposing the blood supply. The vessels (or artery alone depending upon whether the operation is to be a splenectomy or a simple arterial ligation) are then individually tied. When the vessels are approached by way of the gastrosplenic ligament it is first necessary to doubly ligate the vasa brevia and the left gastroepiploic vessels as they run to the stomach from the splenic artery. And when a splenic arterial ligation alone is the operative procedure, to this chief arterial ligation must be added ligation of the left gastroepiploic vessel (branch of splenic) to cut off any arterial supply to the spleen by way of the latter vessel from the right gastroepiploic artery.

When a partial splenectomy is to be performed the splenic pedicle may be grasped between the rubber-protected blades of

a large clamp and the blood supply thus controlled while the desired amount of spleen is resected and interrupted mattress or bolstered sutures are applied; the clamp blades are then cautiously opened to see whether hemostasis is satisfactory and if it is not, the clamp is reapplied until additional hemostatic sutures have been taken.<sup>257</sup>

*The Great Abdominal Trunks:* The largest of the abdominal vessels travel posteriorly to the posterior parietal peritoneum. And it is reassuring to know that when the posterior layer of peritoneum remains uninjured these vessels (aorta, common iliacs, inferior vena cava) cannot be severed or torn. Their injury is most likely during heroic attempts at the removal of large retroperitoneal growths or of intra-abdominal masses which have become adherent to the posterior wall, obscuring normal landmarks. To open one of these trunks quite surely and promptly means death for the patient. An immediate fatality may however sometimes be avoided when the severed vessel can be quickly grasped between thumb and forefinger, for although the rate and amount of blood flow after damage is astonishing, the actual pressure is not sufficiently great to make temporary control difficult when the vessel can be caught by the fingers or pressed firmly against a bony prominence, such as a vertebral body. When dissections are being made within retroperitoneal tissues on the posterior abdominal wall it is of exceeding importance that the surgeon attempt to follow natural lines of cleavage and remain within capsular and ligamentous boundaries. Portions of the mass being removed are to be left in situ when it seems that complete removal would render damage to one of the great trunks certain. Yet when the unfortunate accident has occurred of suddenly injuring one of these great vessels complete disaster is not inevitable since numerous instances of ligation or repair by suture of the inferior vena cava and iliac veins have been reported.<sup>258</sup> Attempts at repair, however forlorn the outlook, are amply justified by these reports.

3. RÔLE OF BLOOD VESSELS IN DETERMINING ANATOMICAL ARRANGEMENTS WITHIN THE ABDOMEN. Vessels play a major part in creating adult anatomical conditions. To understand

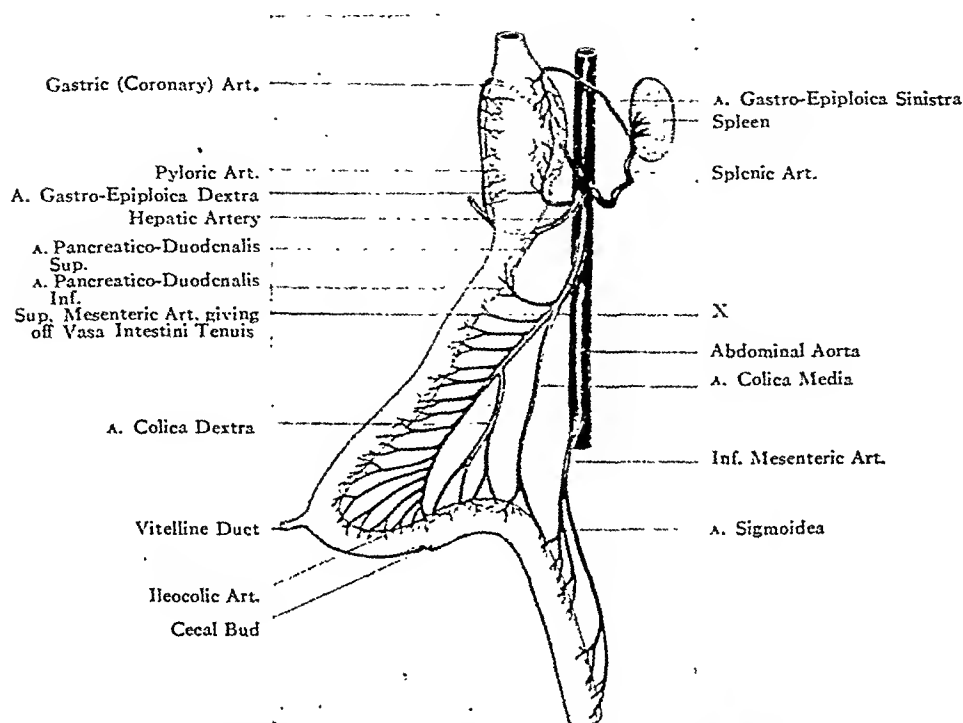


FIG. 178. Relation of superior mesenteric artery to intestinal rotation.

A. Diagrammatic representation of the arteries proceeding to the alimentary canal and appendages prior to rotation of intestine. (Stage of simple umbilical loop.) Rotation of the superior mesenteric artery takes place at the point marked x. (From Huntington)

the mechanism by which they do this, simplifies, as can nothing else, insight into abdominal anatomy. And for the surgeon the "mechanistic viewpoint" enhances his sense of freedom within the abdomen and ensures a more perfect alignment of his maneuvers with normal vital functions. Such advantages are not to be valued lightly.

Peritoneal folds, bands, ligaments, and fossae are dependent to a considerable extent upon the vascular system. The length and position of the jejunoileal mesentery; the size, shape, and location of the foramen of Winslow; the number

and arrangement of the lobes of the liver; also the character and lines of peritoneal attachments of liver, spleen, and kidney; and, in addition, the degree and direction of intestinal rotation,

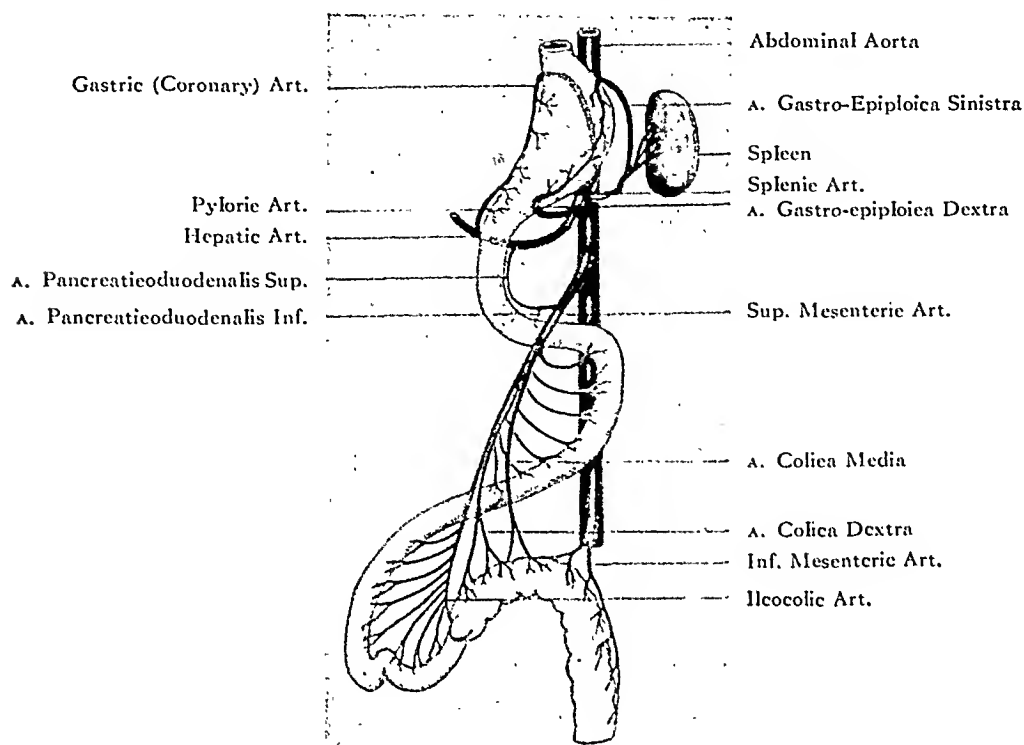


FIG. 178. B. Diagrammatic representation of the arteries of the alimentary canal in the first stage of intestinal rotation, showing relation of superior mesenteric artery to the transverse portion of the duodenum. Note that the artery itself is undergoing rotation. (From Huntington.)

alike are determined in large degree by the mode of distribution of intra-abdominal blood vessels.

It has already been pointed out that the intestines, during embryonic life, rotate upon the axis of the superior mesenteric artery.<sup>259</sup> An accompanying figure demonstrates that the artery itself rotates during the process (Fig. 178). The uppermost or proximal branch of this vessel is the inferior pancreaticoduodenal artery, given off from the *right* side of the main trunk. Before the phenomenon of intestinal rotation has occurred the remaining branches from the right side of the superior mesenteric are the numerous small branches supplying jejunum and ileum; while all other branches (colic

arteries) spring from the *left* side of the parent vessel. After rotation, however, the branches to small intestine now arise from the *left* side of the main trunk and the colic arteries

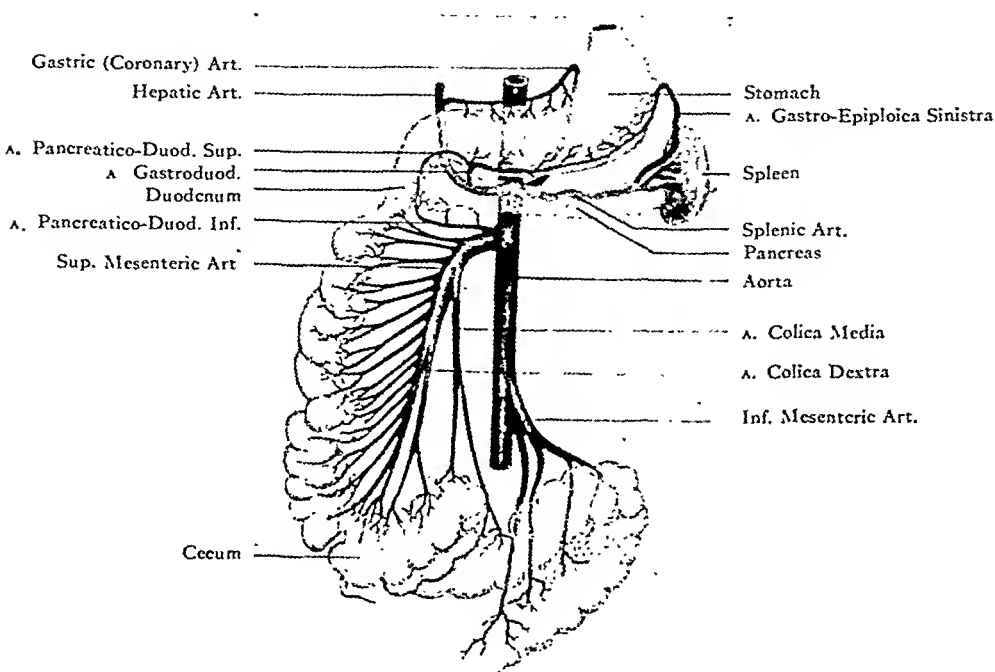


FIG. 179. A. Schematic representation of intestinal arterial supply from superior mesenteric artery in cases of arrested rotation of the intestine. Note position of branches of artery when no rotation has occurred. (From Huntington.)

(right and middle) come from the right side. Thus the final arrangement of branches from the right side of the vessel, named from above downward, is, first the inferior pancreatoduodenal, then the middle colic, then the right colic artery. And it is accordingly seen that the superior mesenteric artery itself, rotates with the primary intestinal loop, the rotation taking place between the first and second arterial branches (at the point marked x on cut) (Fig. 178A). During rotation of the artery the terminal or distal third of the duodenum comes to lie below the superior mesenteric vessels (see duodenomesenteric ileus, p. 218).

The superior mesenteric artery also determines the line of attachment of the jejunoileal mesentery (mesentery proper). The fact that the root of this structure follows an oblique line

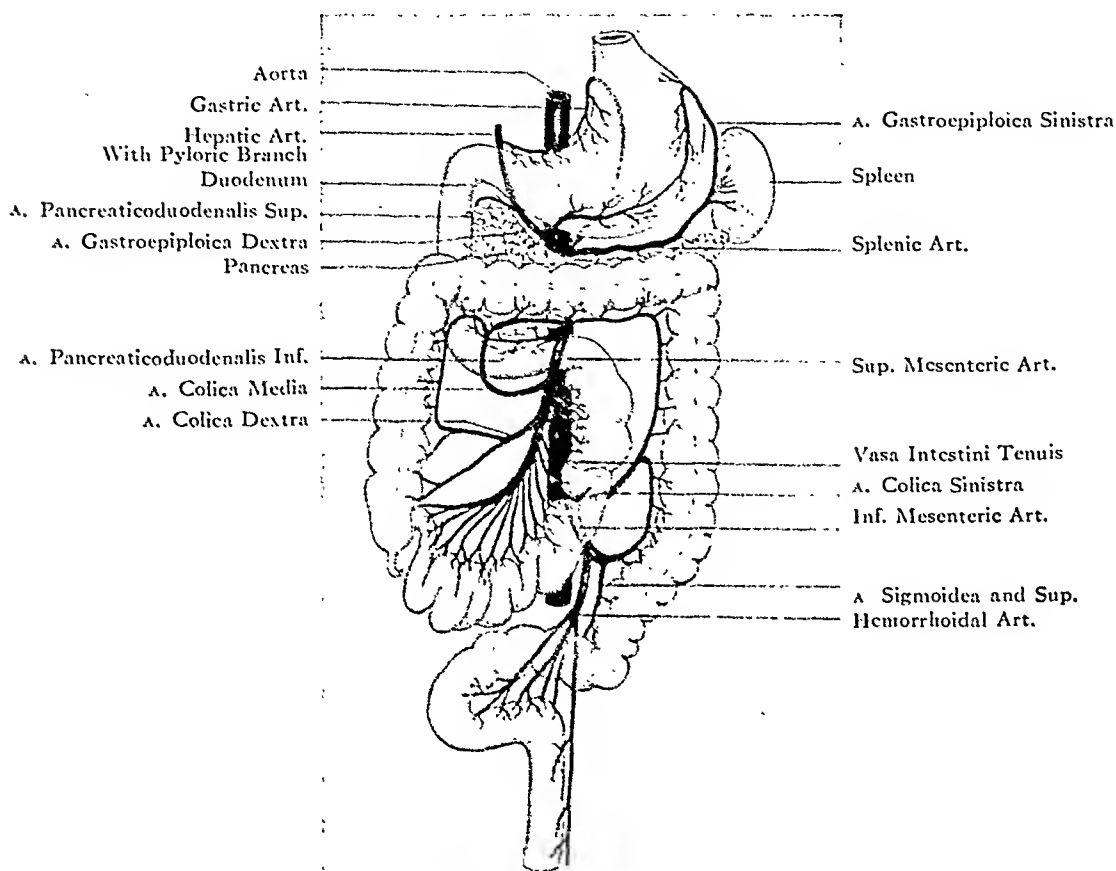


FIG. 179. n. Final arrangement of arteries of alimentary canal after completed rotation of the intestines. Note that the artery itself has undergone rotation. (From Huntington.)

passing downward and to the right from the duodenojejunal junction is due to the fact that it is along this line that the vessel lies at the completion of rotation of the primary intestinal loop. Here peritoneal fusion takes place. When peritoneal fusion is imperfect all of the small intestine may rotate about the artery (ileojejunal volvulus): When the upper attachment is normal but the lower end is imperfect it is the terminal ileum, cecum and ascending colon that rotate (ileoecolic volvulus), creating a mechanical obstruction of bowel.<sup>260</sup>

The foramen of Winslow, as previously pointed out (p. 329) owes its origin to the hepatic artery. For this vessel in taking the shortest distance to reach the porta hepatis from its retroperitoneal origin from the celiac axis throws the overlying peritoneum into a ridge or fold which, upon the completion of duodenal fusion, forms a boundary of the hour-glass constriction constituting the foramen and separating greater from lesser peritoneal cavity. While the common bile duct also traverses the rim of the foramen of Winslow it does not, in the same sense as does the artery, serve to *create* the foramen since when the duodenum is freed from the posterior parietal wall the duct can be lifted up and turned toward the midline; that is, the bile duct does not originate from a fixed retroperitoneal point. The hepatic artery upon the other hand arises from the fixed retroperitoneal celiac axis. The hepatic artery is conveyed to the liver by the free border of the lesser omentum (i.e., in hepatoduodenal ligament) and in traversing this structure it passes the head of the pancreas, the pyloric extremity of the stomach, and the proximal duodenum. In early embryonic life the chief function of the artery (hepatic) is to supply these latter structures (Fig. 179). And only as the liver increases in size and physiological importance does the hepatic portion of the vessel become the part of largest caliber while other branches (right gastric; gastroduodenal) become relatively smaller.<sup>261</sup> The dual function of the hepatic artery of nourishing liver and gastrointestinal tract proper explains the close association throughout life of this artery with the upper part of the small intestine, and why the arterial supply of the entire right extremity of the stomach is derived from the hepatic trunk.

The fact has previously been stressed that a large vessel is to be found within one portion of the margin of each retroperitoneal hernial ring. Here the point is stressed that it is these vessels themselves which serve in large measure to *create* and to account for the peritoneal folds constituting the rings.

The liver, with its five fissures, five lobes (O.T.), five ligaments, and five sets of vessels, represents a less puzzling

anatomical study when the blood supply of the organ at various developmental stages is understood. The depressions upon the under surface of the liver (fissures) are created by vessels; the individual masses of liver tissue (the lobes) are outlined and delimited by vascular trunks or their rudiments; one of the so-called ligaments (round ligament) is simply an obliterated vein. The vascular system plays so definite a causative rôle in determining hepatic anatomical arrangements that these are completely intelligible only upon the basis of insight into hepatic circulation. Since this represents one of the most difficult and important chapters in human anatomy it is obvious that the subject cannot be fully considered here. Reference is given, however, to authoritative source books for this information<sup>262-264</sup>; a sufficient number of summarizing statements are made at this point to give a limited view of the relation between vestigial vessels and adult anatomy; and in subsequent sections of the book (the solid organs; the peritoneal membrane) the subject will be more fully discussed.

The blood vessels of the developing liver vary during different stages of growth with variations in the source of nutriment for the embryo and fetus. Or stated otherwise, circulatory conditions keep pace with altering functional demands. When the sole source of nourishment is the yolk sac the nutriment passes to the embryo by way of two veins (vitelline or omphalomesenteric veins); when the placenta is the pathway for the oxygenated and nutritive blood the chief approach is by way of the umbilical veins (right and left); but when the umbilical cord has been clamped, establishing adult conditions, the child must henceforth be sustained by its own processes of alimentation and the portal vein then becomes the avenue by which materials of intestinal absorption reach the liver and through it the general circulation. The vascular system of the liver must be studied, then, in terms of the following stages: (a) the omphalomesenteric or vitelline stage, (b) the umbilical or placental stage, and (c) the adult or portal stage (Fig. 180).



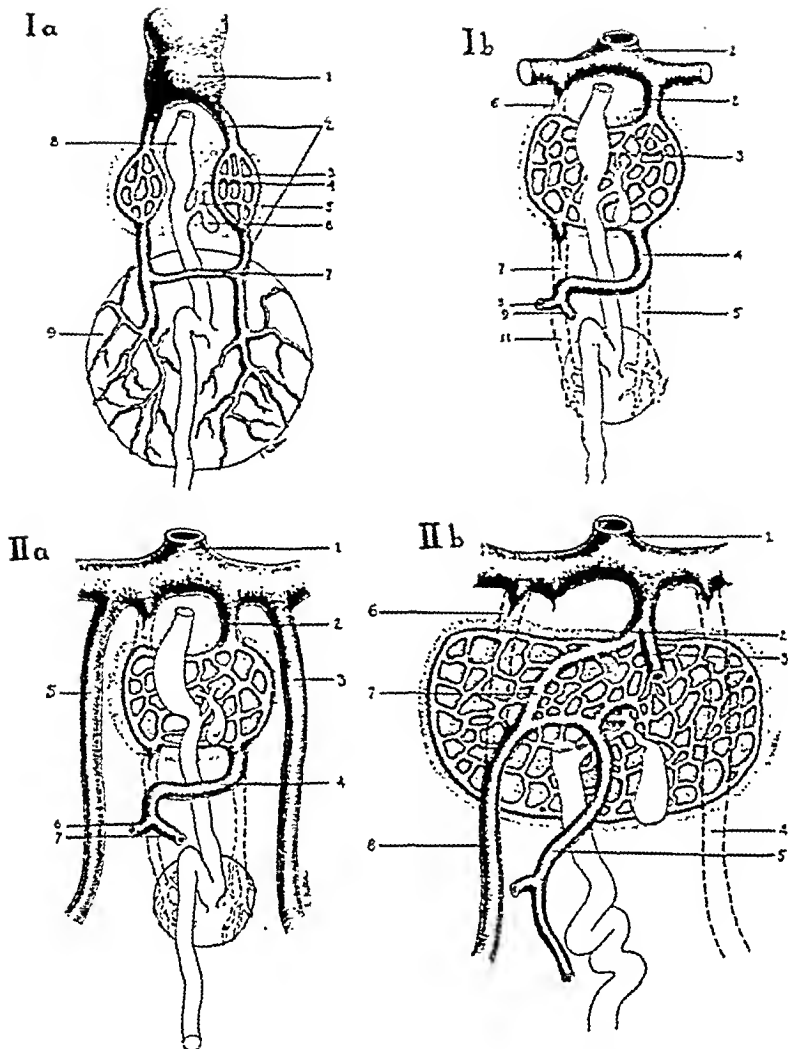


FIG. 180. Relation of fissures and lobes of liver to hepatic blood vessels. (In this series of figures the liver is viewed from behind.)

#### I a and b. The vitelline stage.

1 a. The liver develops about a capillary network along the course of two vitelline or omphalomesenteric veins, which run from the yolk sac to the sinus venosus.

1. Sinus venosus. 2. Vitelline veins. 3. Capillary network about which liver forms. 4. Developing liver (mesodermal portion). 5. Developing liver (endodermal outgrowth from duodenum). 6. Developing gall bladder. 7. Union of vitelline veins. 8. Stomach. 9. Yolk sac.

1b. The portal vein and in part its tributaries develop from the vitelline veins. At this stage the yolk sac has diminished in size and is now a mere yolk vesicle; the portal system has taken on more of the adult form.

1. Sinus venosus. 2. Hepatic vein. 3. Liver. 4. Portal vein. 5. Obliterated portion of right vitelline vein. 6, 7, 11. Obliterated portions of left vein. 8. Splenic vein. 9. Superior mesenteric vein.

#### IIa and b. The umbilical stage.

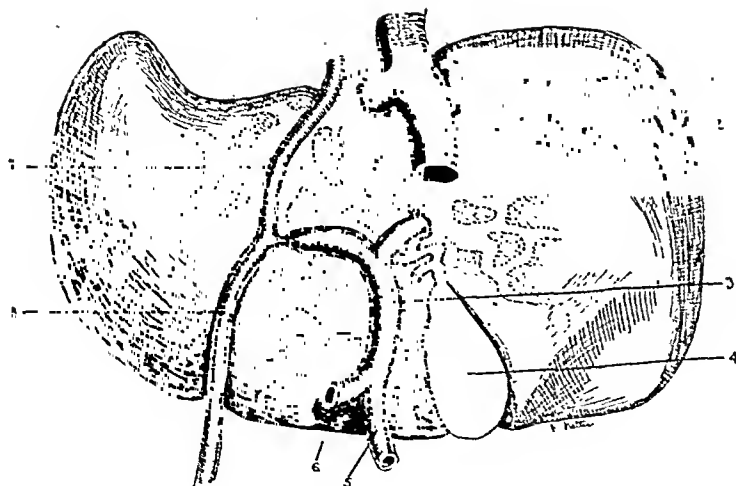
IIa. Two umbilical veins now appear. These are at first independent of the vitelline veins and their capillary net work.

1. Sinus venosus. 2. Hepatic vein. 3. Right umbilical vein. 4. Portal vein. 5. Left umbilical vein. 6. Splenic vein. 7. Superior mesenteric vein.

IIb. The umbilical veins now join the hepatic capillary network but the bulk of the umbilical blood passes directly to the sinus venosus by a special pathway, the ductus venosus.

1. Sinus venosus. 2. Hepatic vein. 3. Portion of inferior vena cava. 4. Obliterated right umbilical vein. 5. Portal vein. 6. Obliterated portion of left umbilical vein. 7. Ductus venosus. 8. Left umbilical vein.

III a



III b

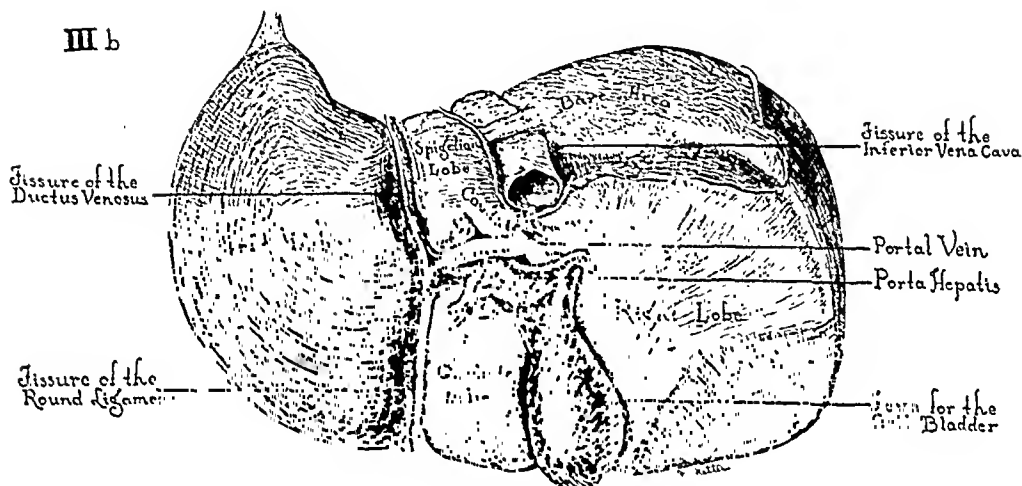


FIG. 180 (Cont.)

III a and b. The portal stage.

III a. When at birth the umbilical cord is ligated blood ceases to flow through the left umbilical vein and this structure and the ductus venosus become mere fibrous cords traversing the under surface of the liver, while the portal vein becomes the only source of venous blood entering liver.

1. Hepatic vein. 2. Inferior vena cava. 3. Portal vein. 4. Gall bladder. 5. Superior mesenteric vein. 6. Splenic vein. 7. Obliterated ductus venosus. 8. Obliterated left umbilical vein (round ligament.)

III b. Final arrangement of the fissures and lobes of the liver.

The lobes are marked and bounded upon the figure. The five fissures take the form of the letter H. The porta hepatis, or hepatic gateway, forms the crossbar of the H. Note the common bile duct, portal vein, and hepatic artery. Forming the left extremity of the H is the old pathway of the umbilical circulation; above, the fissure of the obliterated ductus venosus, and, below, the fissure of the obliterated left umbilical vein which is now the round ligament of the liver. Forming the right extremity of the H-formations are; above, the fissure of the inferior vena cava, and, below, the fossa for the gall bladder. Note that the caudate process separates the fissure for the inferior cava from the fossa for the gall bladder.

During the first stage the two vitelline veins travel upward along the sides of the developing small intestine. They unite near the heart to form a venous sinus (the sinus venosus). Proximal to this point they again unite, forming a network of capillary vessels between yolk sac and primitive heart; and it is about this vascular network that liver cells develop. This vitelline capillary network is the earliest evidence of the portal venous system. The vessels distal to the capillaries become connected with the venous drainage of developing stomach, intestines, spleen and pancreas, i.e., give rise to the portal vein and its tributaries; while the vessels proximal to the venous plexus become the hepatic vein of the adult and aid in the formation of the inferior vena cava. (Fig. 180, 1A, 1B.)

In the second stage two umbilical veins gradually replace in function the vitelline veins. Passing from the umbilicus along the ventral mesogastrium, these reach the venous sinus. At first they are independent of developing liver and the vitelline capillary network; but subsequently they unite with and traverse this set of vessels. The main body of the placental blood forms a large or direct channel through the developing hepatic network to reach the sinus venosus. This is termed the ductus venosus. As will later be noted, both the left umbilical vein leading to this duct (ductus venosus) and the duct itself, leave important markings on the under surface of the developing liver. (Fig. 180, 11A, 11B.)

In the third stage the umbilical veins cease to function, the obliterated left umbilical vein forming the round ligament of the liver. Now the portal vein finally becomes the sole source of venous blood for the liver. (Fig. 180, 111A, 111B.)

The five fissures of the liver are situated upon the under surface of the right lobe and are arranged in the form of the letter H. The crossbar of the H is the transverse fissure or porta hepatis. As implied by the name, this forms the portal or gateway of the organ. Entering are the portal vein, hepatic artery, lymphatics, and afferent nerves. Leaving are the common bile duct, lymph vessels, and efferent nerves. On

the right half of the H-formation are, below, the fissure for the gall bladder (or the gall bladder bed) and, above, the fissure for the inferior vena cava. On the left half of the figure the longitudinal groove represents the depression on liver surface created by the vessels of the old umbilical circulation; below is the fissure for the left umbilical vein (fissure of round ligament) and, above, is the fissure of the obliterated ductus venosus.

The chief lobes of the liver are the right and left. The remaining lobes are, in reality, lobules marked upon the under surface of the right lobe. These additional divisions are the quadrate lobe and the caudate lobe (Spigelian lobe) with its caudate process. The latter (caudate process) is a mere bridge of liver substance connecting Spigelian lobe (caudate lobe) with the remaining portion of under surface of right lobe; its surgical importance is the fact that it lies directly above the foramen of Winslow (foramen epiploicum). The liver, then, possesses four lobes, (right, left, quadrate, and caudate) although under the old terminology the caudate process was considered as a separate lobe, making the lobes five in number. The Spigelian lobe (caudate) lies above the porta hepatis between the fissure for the inferior vena cava on the right and the fissure for the ductus venosus on the left; and the quadrate lobe lies below the porta hepatis between the fossa for the umbilical vein on the left and the fossa of the gall bladder on the right. (Fig. 180, IIIB.)

The ligaments, in addition to the round (obliterated left umbilical vein), falciform (anterior portion of ventral mesogastrium), and coronary (raw or retroperitoneal area connecting liver and diaphragm) are the two lateral ligaments (the right and left triangular extremities of the coronary ligament, extending from liver to diaphragm).

The vessels of the liver, in addition to the portal vein (which carries venous blood *to* the organ), the hepatic vein (which carries venous blood *away* from the organ), and the hepatic artery (which brings arterial blood to the organ from the left ventricle) are the lymphatic vessels and the biliary ducts.

*The Portal Vein and Its Tributaries:* The portal vein conveys blood to the liver from (a) the entire abdominal portion of the gastrointestinal tract, (b) the pancreas, and (c) the

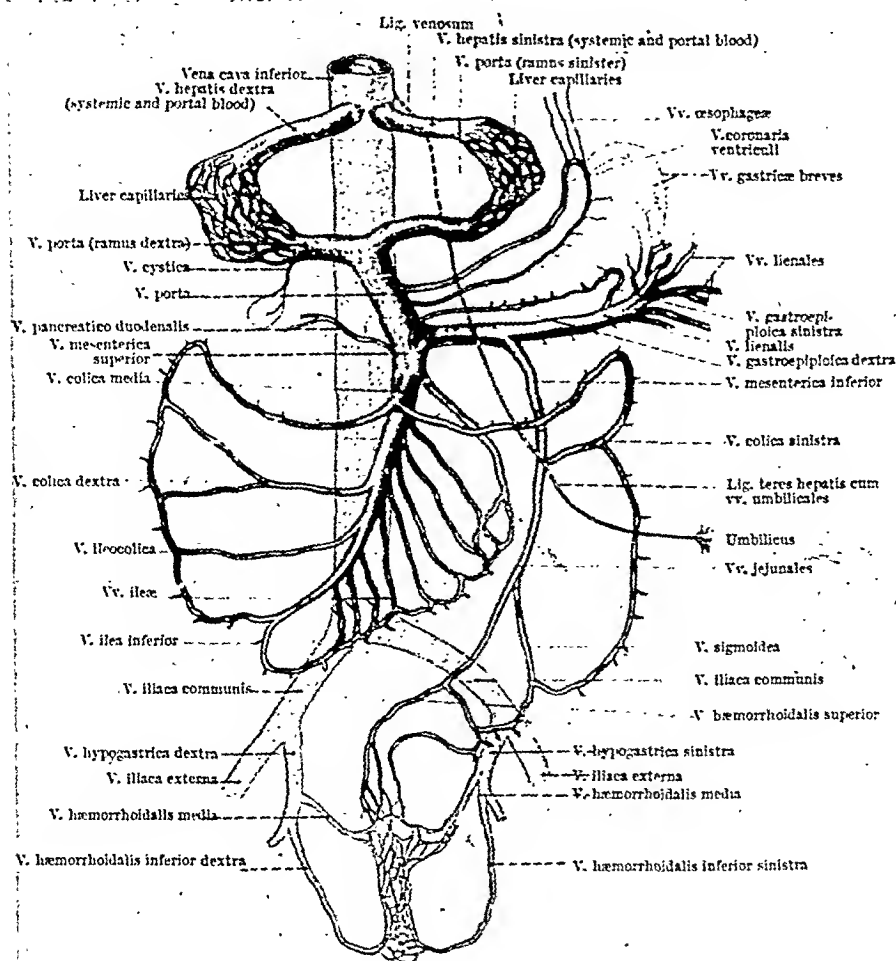


FIG. 181. The portal vein and its tributaries. (From Cunningham.)

It must be recalled that systemic blood carried by the hepatic artery also enters the liver capillaries, therefore the hepatic vein contains both portal and systemic blood.

spleen (Fig. 181). It is formed by the union of the splenic vein with the superior mesenteric vein, this union taking place posterior and to the left of the neck of the pancreas (level of body of second lumbar vertebra). The portal vein before passing into the liver divides into a right and left

branch. Accompanying figures illustrate the ramifications of the portal system. Many practical surgical points are determined by this arrangement of the vessels which drain into the liver. For example, the cystic vein drains, not into the main portal trunk but into the right branch; and with cholecystitis complicated by secondary infection within the liver the pathological changes (abscess, inflammation, atrophy) are confined to the right lobe (portal capillary system and adjacent liver cells). Generalized pylephlebitis following appendicitis and other abdominal and pelvic infections has already been discussed (see p. 434). A line drawn from the fundus of the gall bladder to the inferior vena cava serves to map out the liver substance supplied by the right and left branches, respectively, of the portal vein; the surgeon may find metastatic malignant nodules within the liver to be limited in a remarkable fashion upon one or the other side of this imaginary line, demonstrating by which branch of the portal vein the malignant embolus or emboli reached the liver tissues.<sup>265</sup> Since the portal vein passes below the neck of the pancreas on its way to the liver the clinical picture of portal obstruction (see p. 186) may be caused by hardening of the head and neck of the pancreas (carcinoma) as well as by disease along the vessel elsewhere (metastatic nodule) or within the liver itself (cirrhosis). The much greater size of the superior than of the inferior mesenteric vein is an anatomical demonstration that it is the small intestine, especially in its upper portions, which is the great absorptive division of the gastrointestinal tract. And the importance of the liver in the process of nutrition and as a filter for toxic substances is shown by the fact that all the venous blood from the small and large intestines must pass through this organ before entering the circulation. Some of the fatalities following the Talma operation, or other operations designed to short circuit the venous blood to the systemic vessels without first reaching the liver, have been attributed to the lack of detoxification of the blood from the intestine when the liver has been excluded.<sup>266</sup>

Thus one function of the portal vein, then, is to carry to the liver toxic products and foreign particles which have been absorbed from the intestinal tract that they may be rendered harmless. This chemie defense by the liver against noxious substances is illustrated by the conjugation of indole, skatol, phenol, and cresol, chiefly with potassium sulphate. Potassium indoxyl sulphate or indican is the indigo-forming substance found in the urine when protein putrefaction is excessive.<sup>267</sup> And the removal of foreign particles from the portal circulation is accomplished largely if not wholly by the activity of the Kupffer cells of the liver, which like other cells of the reticulo endothelial system show active phagocytic properties.<sup>268</sup>

Another function of the portal vein is to carry monosaccharides to the liver. All sugars and starches taken into the alimentary canal must be converted into monosaccharides before they can be absorbed. These simple sugars, for the most part, are then converted by the liver cells into glycogen and thus stored in the hepatic tissues for future use. This storage of carbohydrates within the liver was first demonstrated by Bernard in 1848.<sup>269</sup> The process of glycogen storage may be expressed thus; dextrose minus water equals glycogen, or  $C_6H_{12}O_6 - H_2O = C_6H_{10}O_5$ . When sugar is subsequently required for nutritive purposes the glycogen is reconverted into dextrose by the action of a ferment.

Still another function of the portal vein is to carry to the liver the end-products of protein digestion and absorption (amino-acids).

#### D. ABDOMINAL LYMPH VESSELS AND LYMPHATIC GLANDS

1. THE VESSELS. While dextrose and amino-acids are absorbed by the blood vessels of the portal system and carried directly to the liver, fats pass to the systemic circulation for the most part by way of the lacteals and the thoracic duct (Fig. 182). They are prepared for passage through the intestinal mucous membrane chiefly by the action of the

pancreatic enzyme lipase or steapsin. The action consists of a cleavage of the neutral fats into fatty acids and glycerin. These fatty acids then combine with alkalies chiefly sodium or potassium carbonates furnished by the alkaline bile, forming special salts known as soaps (salts of fatty acids). Absorption of fats from the intestinal tract does not occur until soaps have been formed.

When, then, either pancreatic juice or bile is deficient fat digestion and absorption are interfered with; and ingested fats fail to reach the lacteals and thoracic duct but pass almost unaltered through the gastrointestinal tract to be discharged rectally. Fatty stools are of particular diagnostic import with diseases of the pancreas. When the pancreatic ducts are blocked the motions are soft, frothy, and soapy, and may be enormous in quantity due to the inadequate digestion. This sign is termed *steatorrhea* (from Gr. *stear*, tallow + *rhoia*, a flow). As first described by Claude Bernard the stools are also light in color.<sup>270</sup> The dark color of normal feces is not, as is often supposed, due to bile pigments, for these are absorbable; but is caused by an insoluble pigment which is the result of the action of pancreatic juice upon bile. The absence of either pancreatic juice or bile results in the passage of unpigmented feces. To this lack of color with pancreatic disorders is added a distinct whiteness of the motions from the presence of the large quantities of undigested fats. Fats may be detected in the stools in three forms: fat droplets, crystals of fatty acids, and as soaps. When pancreatic lipase is absent so also is pancreatic trypsin and quantities of undigested meat fibers (*azotorrhea*, Gr. *azote*, nitrogen + *rheo*, I flow) are simultaneously found. This adds to the bulk of the motions, their outstanding characteristic.

Tissue fats as well as ingested fats are sometimes attacked by the pancreatic fat-splitting ferment and in such a pathological process the lymph channels probably play a rôle in the distribution of the enzyme to body fats. During operations for acute pancreatitis (pancreatic necrosis) peculiar



white spots are encountered within the intra-abdominal fat (omentum, mesentery, abdominal wall). These discrete, dull, whitish patches are in sharp contrast to the yellow and

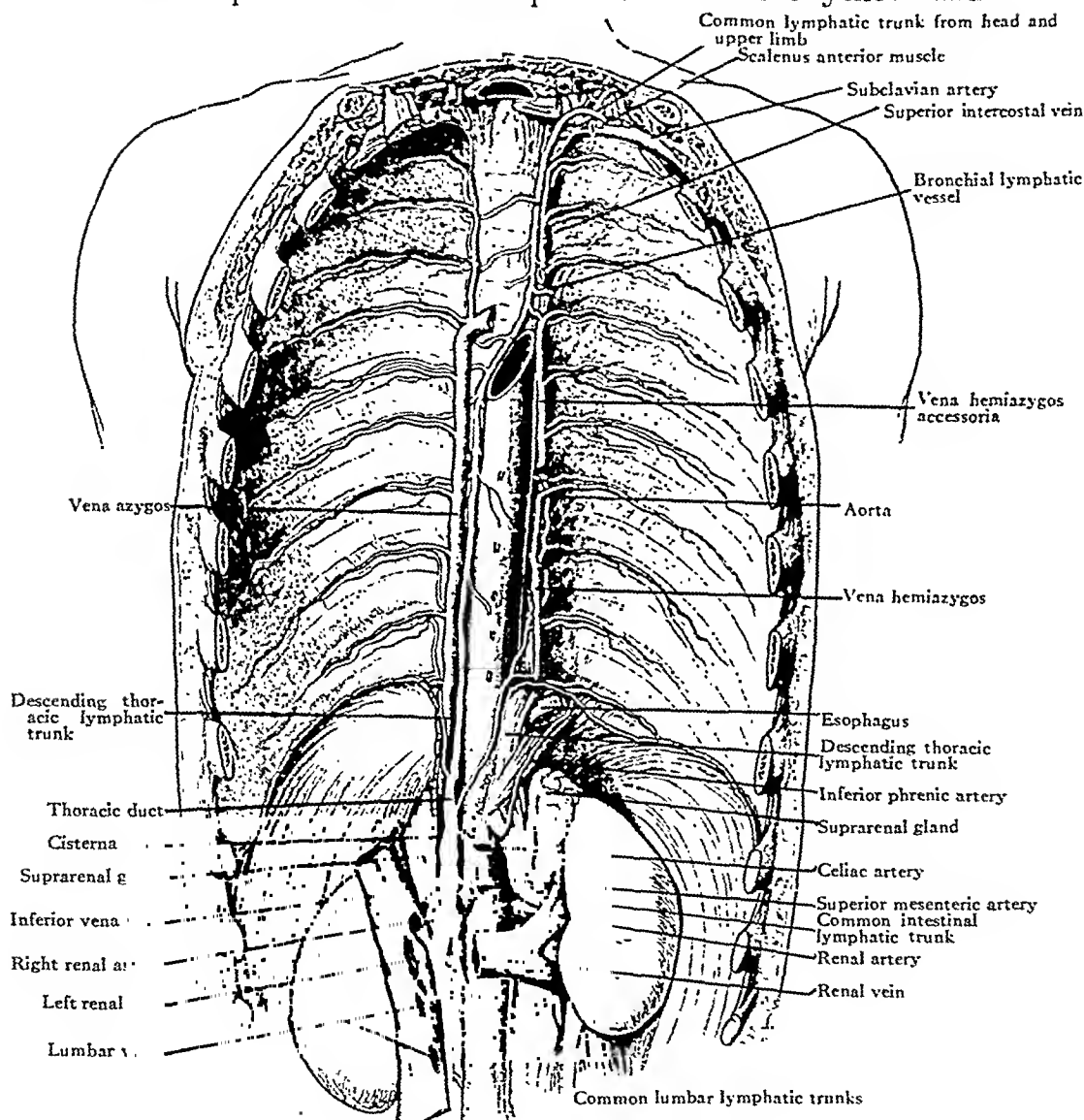


FIG. 182. A. The thoracic duct and its tributaries. (From Cunningham.)

glistening fat which surrounds them. They are most marked in the vicinity of the pancreas but may be widely scattered.

Pancreatic lipase has been recovered from these necrotic spots.<sup>271</sup> This definitely proves them to be due to the action of the fat-splitting ferment (Fig. 183). The neutral fats here,

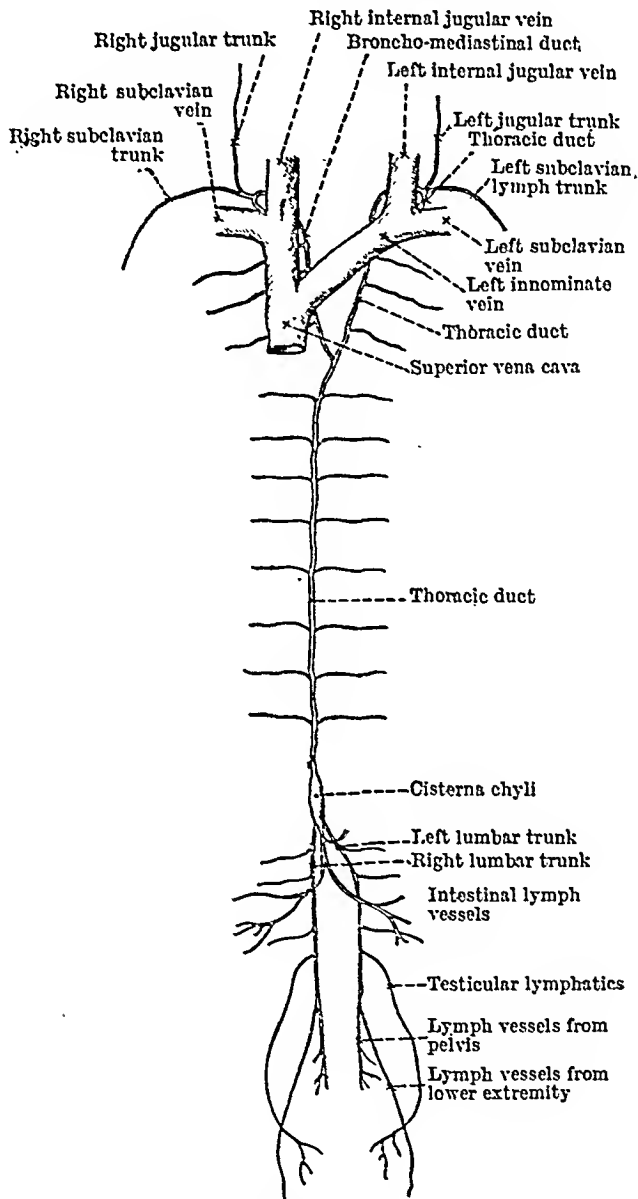


FIG. 182. B. Diagram of main lymph vessels of lymphatic system. (From Cunningham.)

as within the intestinal canal, are broken up into glycerin and fatty acids while the latter combine with calcium forming insoluble soaps. The scattered nature of areas of fat necrosis

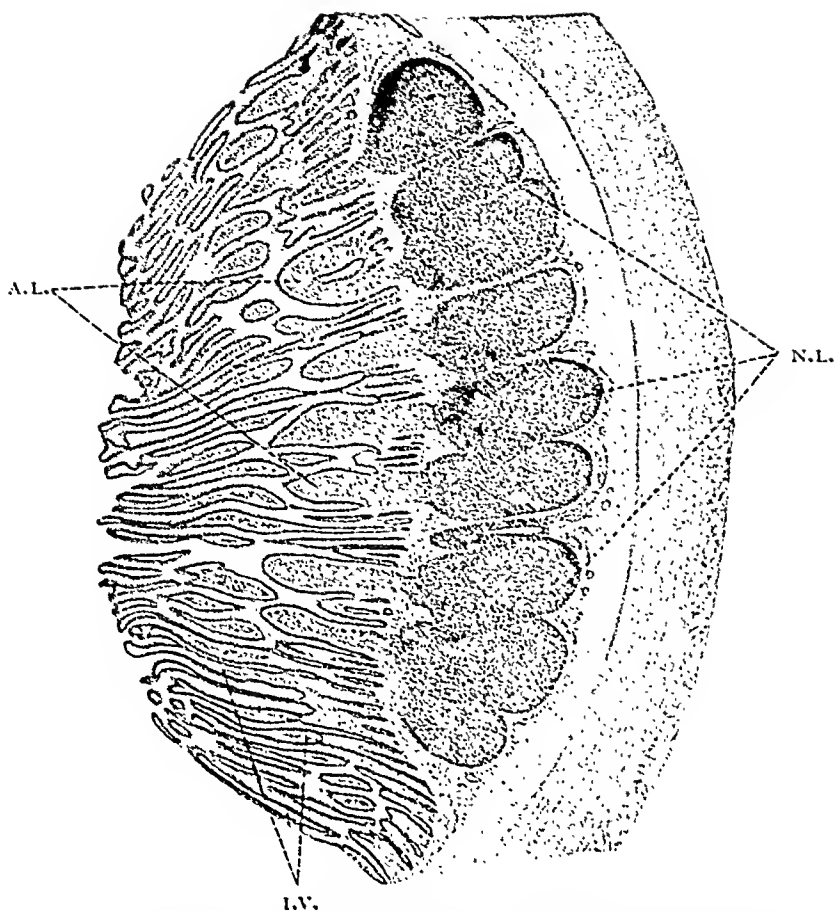
shows that the lipase has not reached the tissues by simply pouring over the peritoneal surface. If this had occurred the involved islands would be large and the surface endothelium



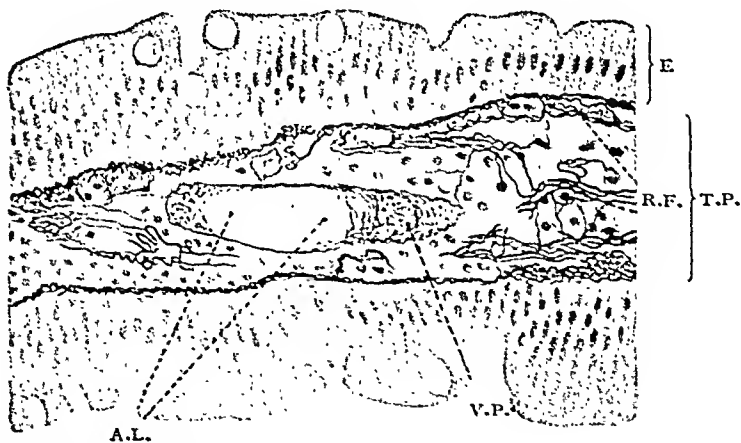
FIG. 183. Fat necrosis in the omentum following blockage of pancreatic ducts. (From MacCallum's Pathology, Saunders.)

would also be found involved. Since patches of fat necrosis are small and the endothelium is uninvolved the suggestion seems more likely that the digestive fluid has traveled by way of lymph or blood channels.<sup>271</sup>

The products of fat digestion are carried to the thoracic duct by way of the lacteals. These may be seen by the surgeon during the course of operations, particularly when performed shortly after patients have eaten fat-containing meals. They appear within the mesentery as abundant white streaks or channels passing away from the intestinal walls along adjacent blood vessels, (*L. lacteas*, milky or white). Lacteals are, in reality, the lymph vessels of the small intestine. Like lymph



A. Cross section of intestinal wall showing villi with their axial lacteals. (From Sabota.)  
 A.L., wall of axial lacteal cut tangentially; N.L., noduli lymphatici aggregati; I.V., intestinal villi.



B. Longitudinal section of a villus. (From Sabota.)  
 E, epithelium; T.P., tunica propria; R.F., reticulum fibers; V.P., villus-like processes of lymph follicles;  
 A.L., axial lacteal.

FIG. 184. Origin of lacteal in intestinal villus.

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vessels elsewhere they constitute a system of minute, delicate, and transparent vascular channels. Lacteals arise from the villus projections on the inner wall of the intestinal tract. The complicated structure of a villus, with its base of adenoid tissue, fine vascular plexus, unstriped muscle fibers, nerve endings, and delicate lacteal vessel, is shown in an accompanying illustration (Fig. 184A).

The lacteals drain into adjacent mesenteric lymph glands. These lymph glands (described in detail later) appear creamy or white whilst the chyle is passing through them; but when the fatty current is not active they become a rosy pink. From the peripheral glands larger lymph vessels pass to more central glandular groups. By repeated vascular unions larger and larger channels form until the main tributary (truncus intestinalis) of the cisterna chyli has been formed. This intestinal lymphatic trunk drains the small intestine, spleen, pancreas, stomach, and lower and anterior part of the liver. The cisterna chyli into which the truncus intestinalis drains represents an elongated ovoid dilatation of the thoracic duct at its point of origin in the epigastric region (see Fig. 182A).<sup>272</sup> The cisterna is approximately 3 in. in length and  $\frac{1}{4}$  to  $\frac{1}{3}$  in. in diameter. It lies behind the right crus of the diaphragm; it overlies the first and second lumbar vertebrae. It is situated between the abdominal aorta on the left and the vena azygos on the right. From the cisterna the thoracic duct leaves the abdomen by way of the aortic opening in the diaphragm. After traversing first the posterior, then the superior mediastinum, it reaches the left innominate vein at the point of commencement of this vessel at the medial border of the left scalenus muscle. Accompanying illustrations of the lymph vascular system as a whole show that the entire lymph supply (from abdomen, thorax, body walls, extremities, head and neck) ultimately reaches the innominate veins (on the left by way of the thoracic duct, and on the right by the right lymph duct). The entire lymph current of the body is, then, directed toward the innominate veins at their points of origin in the neck.

Concerning the thoracic duct several practical points have previously been dealt with. On page 182 causes of duct blockage were mentioned together with the signs and symptoms of this condition. On page 184 chylous ascites was discussed and this condition differentiated from chyliform ascites. And on page 174 the significance of the so-called Virchow-Troissier gland in the left cervical region (lymph node lying behind clavicular origin of sternomastoid muscle) was described and the passage of malignant emboli or extensions along the thoracic duct discussed. The extreme emaciation of the patient illustrated on page 445 as a sufferer from an abdominal aneurysm presumably was due to blockage of the thoracic duct at the aortic opening of the diaphragm. With the consideration of mesenteric cysts (p. 356) mention was made of chylous cysts; and these small, chronic, tense, globular, almost symptomless masses were differentiated from dermoids, lipomata and other mesenteric neoplasms. And with reference to edema of the lower extremities, it was pointed out that conditions which cause increased venous pressure within the left subclavian vein (mediastinal tumors, cardiac disorders) necessarily interfere with emptying of the thoracic duct into the vein, which tends to produce duct stasis with resulting stasis also within lymph vessels which drain into the cisterna chyli from the lower extremities.<sup>273</sup>

2. THE LYMPH NODES.\* Abdominal lymph glands or nodes may be separated into two chief sets, (a) the superficial groups located within or draining the abdominal walls (umbilical nodes, inguinal nodes), and (b) the deep glands which are located within the abdominal cavity (gastric nodes, mesenteric nodes, lumbar nodes).

Normal lymph nodes are firm, ovoid, flattened bodies which vary from pinhead size to nodules 1 cm. in their longest diameter. Their typical bean-shape is caused by a localized depressed area known as the hilum. Lymph glands are freely movable for they lie within loose connective tissues,

\*The terms lymph glands and lymph nodes will here be used interchangeably.

some being subcutaneous in location but the majority being deeply situated adjacent to great blood vessels. The glands are usually arranged in groups of from two to fifteen, but

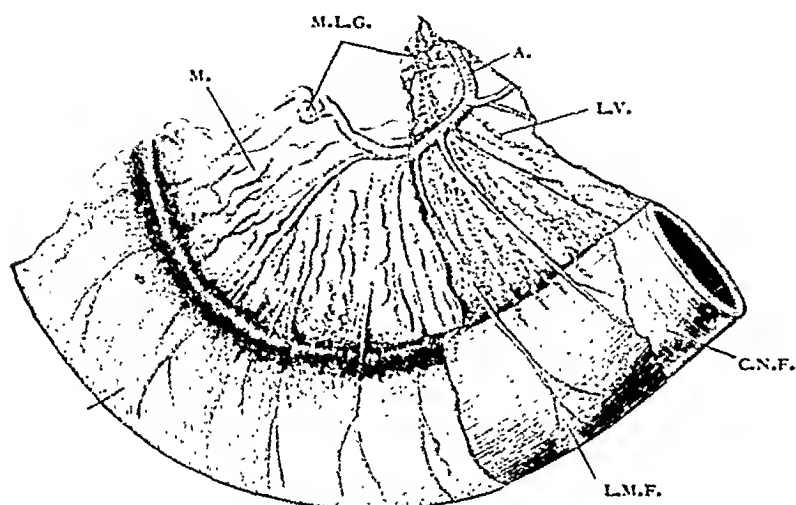


FIG. 185. Mesenteric lymph glands with their afferent and efferent lymph vessels.

The afferent lymph vessels (L.V.) pass to the gland (M.L.G.). The efferent vessels are shown as they leave the gland to pass to more centrally located glandular groups. (From Cunningham.)

superficial nodes are sometimes solitary. The masses form centers to which afferent lymph vessels converge and from which efferent lymphatics pass to more centrally located glandular groups and to larger lymph vessels (Fig. 185). The color and consistency of these bodies vary slightly with the tissues in which they are situated and with their state of functional activity. Microscopically a node is divided into a cortical and a medullary area; a supporting network of white fibrous tissue interspersed with elastic and sometimes unstriped muscular fibers encloses lymph sinuses, lymph follicles and cords (Fig. 186). The nodes act as lymph filters and also give rise to certain of the lymphocytes found within the blood stream. They constitute an important division of the reticulo-endothelial system.

In examining lymph glands, whether external groups studied as an aid to clinical diagnosis or internal sets studied

during the course of operations as an aid to intra-abdominal diagnosis, the surgeon should keep constantly in mind, as the various clusters are systematically investigated, the areas

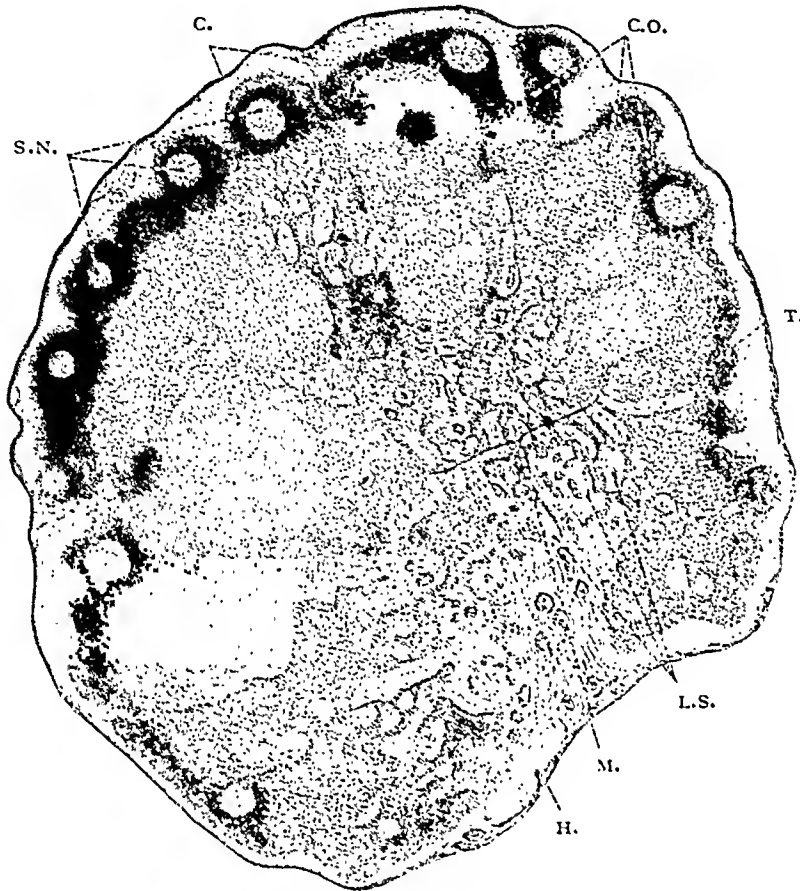


FIG. 186. Cross section of a lymph node. (From Sabota.)

C, capsule; S.N., secondary nodules; C.O., cortex; T, trabecula; L.S., lymph sinus; M, medulla; H, hilum.

to which individual glands give drainage and the deeper areas to which they in turn drain. Points to be particularly noted concerning lymph glands are: 1. Exact size (number of nodes enlarged; precise arrangement of the various sizes with reference to the dominant gland of the group. 2. Shape (regular; irregular). 3. Surface (smooth; nodular). 4. Consistency (stony hard; hard; firm; soft cystic). 5. Tenderness (painful on palpation; painless). 6. Relation to adjacent glands (matted or discrete). 7. Relation to other neighboring



tissues (free and movable; fixed to skin; fixed to deep structures). 8. Periglandular states (associated redness, pigmentation, edema).

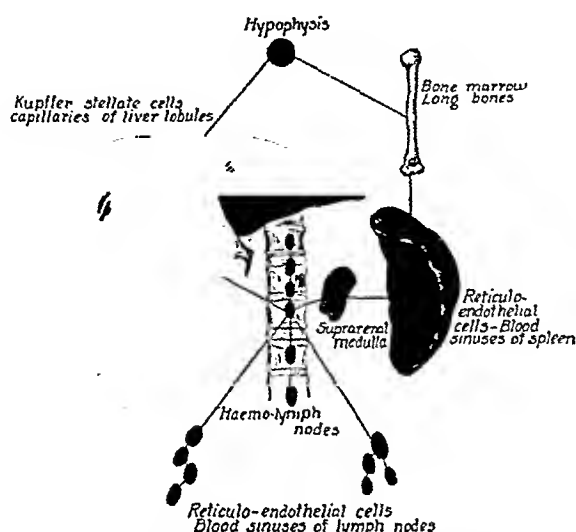


FIG. 187. Relation of lymph nodes to hematopoietic system.  
(From Bell in *Surg., Gynec. Obst.*)

Diseased abdominal lymph glands, as those elsewhere in the body, are of five chief types:<sup>274</sup>

1. Inflammatory lymphadenomata.
2. Tuberculous lymphadenoma.
3. Syphilitic lymphadenoma.
4. Malignant lymphadenomata (metastatic).
5. Primary or essential lymphadenomata (leucemic glands; Hodgkin's nodes; lymphosarcoma).

These various types present quite typical clinical pictures. For example, with an *inflammatory lymphadenoma* (enlarged gland caused by the staphylococcus or streptococcus) a regional focus of infection or history of a recent regional focus is the rule; the swelling is of relatively short duration; the gland is tender; redness and other cardinal signs of Celsus are associated; edema tends to obscure the glandular outlines and the mass may thus be fixed to the fascial bed; early supuration often occurs; and the presence of temperature,

rapid pulse, and typical leucocytosis point to the correct diagnosis.

*A tuberculous lymphadenoma* shows the characteristics of



FIG. 188. Clinical consideration of inguinal lymph nodes, showing a, glands along femoral vessels; b, glands along Poupart's ligament, and, c, pubic glands.

the tubercles which constitute and determine the enlargement.<sup>275</sup> The tubercle is of slow growth, so the lymphadenoma is chronic and of insidious onset; a tubercle has no nerve ending, so the tuberculous gland is usually painless; the tubercle is non-vascular, so the gland, if not secondarily infected, is cool to the touch, pale in color, and tends to break down or caseate. A local condition of matted glands, with multiple sluggish sinuses is typical; yet early tuberculous involvement may yield glands quite indistinguishable clinically from lymphatic swellings due to other causes. The history of tuberculosis elsewhere (childhood cervical glands, pleurisy with effusion, gastroenteric tuberculosis, family

history of phthisis) is of diagnostic significance, and the blood picture and other laboratory data may aid in establishing the cause of the tumefaction.



FIG. 189. Palpating for enlarged inguinal lymph nodes.

*Syphilitic glands* are "shotty," firm, discrete, painless, freely movable, and small (seldom being enlarged beyond twice the normal dimensions).<sup>276</sup> Subsequent to the local regional involvement near the primary lesion (chancre), the glandular enlargement becomes generalized, including the occipital, and other sets of nodes not ordinarily a part of a generalized lymphadenopathy. Luetic glands are chronic, often remaining palpable for years. When such glands are present the history of a chancre or the presence of a positive Wassermann reaction establishes the diagnosis beyond reasonable doubt.

*Metastatic malignant nodes* show typical stony hardness, irregularity, absolute fixity, persistent growth, invasive or infiltrating qualities and a regional relationship to primary foci.<sup>277</sup> The primary tumor may be so small as to escape any but a most thorough examination of the drainage basin of the involved nodes. And due to the frequency with which lymph

vessels become plugged or obstructed by malignant cells aberrant implantations and retrograde metastases are common.

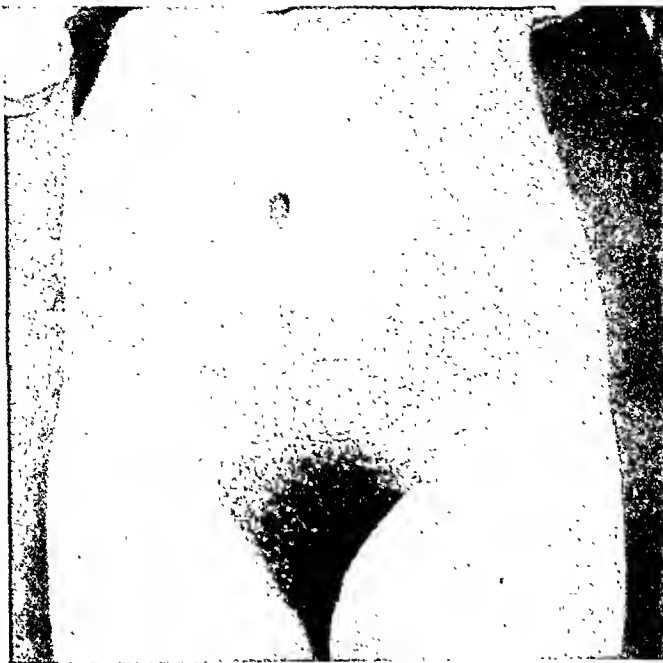
So-called *primary or essential lymphadenomata* (or lymphomas) in general tend simultaneously to effect many glands in many groups; to form large, rounded, lobulated masses,<sup>278</sup> to show little or no tendency to soften or to suppurate; to be always movable on deeper structures (in distinction to masses of sarcomatous tissue of other origins); and to be of steady growth (never disappearing even during periods of temporary remission). All primary lymphomas are of unknown origin and are uniformly fatal. The difficulty of distinguishing between the essential lymphomas is increased by confusion regarding terminology; for by some the separate textbook pictures are held to be but various phases of a common process.<sup>279</sup> When there occurs an overwhelmingly rapid and huge enlargement of a single lymph gland the condition is termed a lymphosarcoma or malignant lymphoma. In the presence of a large swelling of one group of glands before the rest (neck, mediastinum) but followed by moderate enlargement of the spleen, and after weeks or months by generalized swelling of lymphatic glands, the term multiple lymphoma or Hodgkin's disease is employed. Here the occurrence in youth or early adult life, the presence of periodic febrile attacks of several days' duration, the essentially negative blood picture (anemia only or occasional presence of myelocyte or basophilic corpuscle) and above all the continual domination of the picture by the primary glandular group are among characteristics consistent with this diagnosis. A widespread involvement through the body of lymph glands which show the previously described characteristics of primary lymphadenomas and associated with early appearance of a considerable leucocytosis with great relative increase in lymphocytes calls for the diagnosis of leucemia.

Granuloma inguinale is discussed elsewhere.

In accumulating data upon which to establish the nature of a specific glandular enlargement or to reach a suggested

or presumptive diagnosis the following methods may be employed:<sup>250</sup> (a) Note minute details concerning the involved glands as just described. (b) Study regions drained by affected nodes (afferent pathways). (c) Study regions to which involved glands drain (efferent pathways). (d) Review condition of palpable glands throughout body. (e) Examine the spleen. (f) Investigate the blood picture. (g) Perform exploratory puncture or biopsy, securing tissue for serial microscopic study, bacterial and tissue cultures for animal inoculations. (h) Correlate the physical and laboratory findings, with data obtained from a detailed history.

Inguinal lymph glands are affected by all of the causes of lymphadenopathies described already. But by far the most common cause of enlargement exclusively of inguinal glands is septic absorption from some inflammatory focus.<sup>251</sup> Figs. 188 & 189. The particular group of groin glands involved gives some index as to the site of the primary process (femoral chain, pubic group, median, upper, and deep inguinal glands, circumflex iliac set, external iliac or supra femoral group). Examination of the toes and between the toes, of the foot, ankle, leg, thigh, buttocks, lower back, lower anterior wall, scrotum, penis, perineal and vulval regions is indicated; and urethral discharges are to be sought. The characteristics of the inflammatory glands themselves and of the systemic reactions have been described. Syphilitic lymphadenopathies are common in the inguinal region, particularly in association with a chancre; and the association of buboes with *B. Ducrey* infection is well known. Tuberculous and leucemic lymphatic swellings in the inguinal regions alone are uncommon; and glandular involvement with Hodgkin's disease usually occurs first and maximally elsewhere. Malignant lymphadenomata, both primary and secondary, are by no means uncommon in the inguinal region. The most frequent malignant lymphadenoma here is a secondary epithelioma of the squamous-cell type, usually of perianal origin. Secondary carcinomata (from, a primary lesion within some point in the wide area mentioned



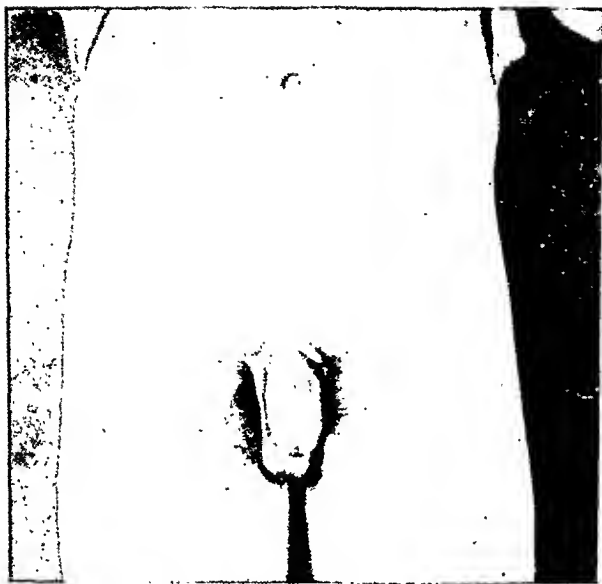
A. Suppurative inguinal lymphadenitis. (From Third Surg. Div., Bellevue Hosp.)



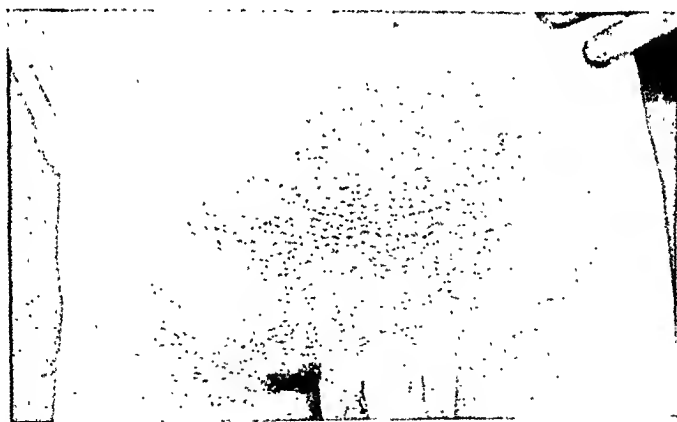
B. Lipoma of upper thigh. (From Third Surg. Div., Bellevue Hosp.)

FIG. 190. Various masses in the region of the groin.

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c. Undescended testicle in thirteen-year-old boy. The non-descended testicle is present as a small tender mass within the inguinal canal. (From Third Surg. Div., Bellevue Hosp.)



d. Femoral hernia. (From Third Surg. Div., Bellevue Hosp.)

FIG. 190.



E. Sublingual fibrolipoma. (From Third Surg. Div., Bellevue Hosp.)



F. Inguinal lymphadenoma due to lymphatic leucemia. (From Third Surg. Div., Bellevue Hosp.)

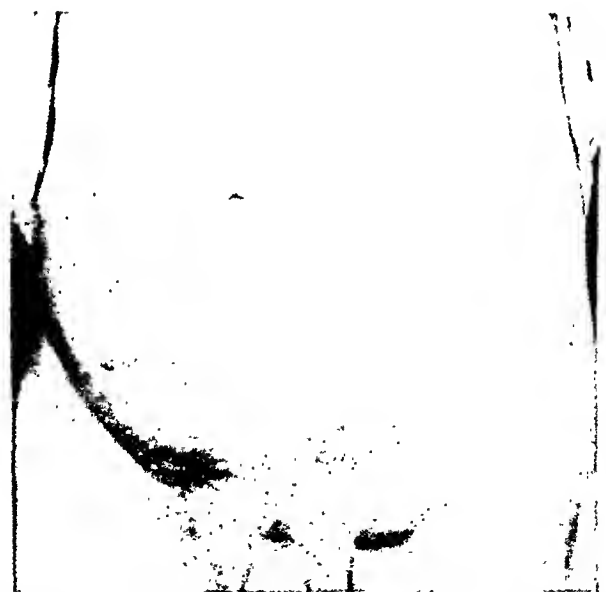
FIG. 190.

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g. Left direct inguinal hernia, simulating femoral hernia. (From Third Surg. Div., Bellevue Hosp.)



h. Left femoral hernia. (Cf. Fig. 100b.) (From Third Surg. Div., Bellevue Hosp.)

FIG. 190.

under inflammatory lymphadenopathies) and secondary melanosareomata occur, though less often than do secondary epitheliomata. Primary inguinal lymphosarcoma is extremely rare. Diagnostic difficulties include not only a differentiation of the various types of lymphadenopathies but the distinguishing of glandular enlargements from masses such as hernias, psoas abscesses, undescended testicles, hydroceles, localized abscesses, tumors of cord or round ligament, and other inguinal affections (see individual headings) (Fig. 190).

The lymph glands situated within the abdomen are affected by the same conditions which affect nodes elsewhere. The separate groups of intra-abdominal glands will be illustrated and described; and the following topics will be discussed: regional lymphadenitis due to local intra-abdominal infections; regional lymph gland metastases with intra-abdominal malignancies; *tabes mesenterica*; abdominal Hodgkin's disease; abdominal glands of leukemia; intra-abdominal lymphosarcomatosis.

#### QUESTIONNAIRE

1. Describe the blood supply to ileum and jejunum.
2. Discuss control of vessels during resection of a short segment of jejunum or ileum.
3. Describe in detail control of vessels for a long segment of jejunum or ileum.
4. What is the relation between the movability of various parts of the gastrointestinal tract and the proximity of the main arteries supplying these parts?
5. Name the portions of intestinal tract supplied with mesenteries or mesocolons and describe the arrangement of arteries within these structures.
6. Describe the application of clamps to the bowel for an intestinal resection when an end-to-end anastomosis is contemplated; when the repair is to be of a side-to-side variety.
7. What is the blood supply of the transverse mesocolon?
8. How is injury to vessels of the transverse mesocolon to be avoided during the performance of a posterior gastroenterostomy?
9. What arterial anastomosis marks the union of functional fore gut with mid gut; of junctional mid gut with hind gut?
10. What are the causes of postoperative bleeding after a gastroenterostomy?
11. What is the surgeon to do, if at the completion of a gastro-enterostomy, there is still bleeding along the site of anastomosis?
12. Describe the blood supply of stomach.
13. What arteries must be ligated in performing a subtotal gastrectomy?
14. What is an internal hernia; a retroperitoneal hernia?
15. Name the chief sites at which retroperitoneal hernias develop.
16. What is the frequency with which the following hernias occur; hernia into foramen of Winslow, intersigmoid hernia, pericecal hernia, paraduodenal hernia?

17. What important vessels are found at the foramen of Winslow?
18. What is a "right duodenal hernia"; a "left duodenal hernia"; which is the more common?
19. Who first described a retroduodenal hernia in the region of the duodenojejunal junction?
20. Describe the orifice of left duodenal hernia. What important vessels form part of the orifice?
21. What is the forus of Landzert; the forus of Willebrand; the vascular arch of Treitz?
22. Describe the orifice of right duodenal hernia; the important vessels in relation to these hernias.
23. Describe the different varieties of peritoneal hernia and name important vessels in relation to these hernias.
24. Describe the interstigmoid forus, interstigmoid hernia and the blood vessels in the region of these hernias.
25. How may injuries to important vessels be avoided in reducing retroperitoneal hernias or in repairing the orifices through which these develop?
26. Describe the blood supply of the spleen.
27. What is the splenic pedicle; the gastrosplenic ligament; the splenorenal ligament? Name the vessels in each of these structures.
28. Discuss various approaches at which the splenic artery may be ligated.
29. How may injury to the tail of the pancreas be avoided in performing a splenectomy?
30. Describe the right gastroepiploic artery; the vasa brevia.
31. What is the relation of the aorta and the inferior vena cava to the peritoneum?
32. Discuss the control of hemorrhage after accidental injury to the inferior vena cava.
33. Name some of the important intra-abdominal arrangements which are determined by abdominal vessels.
34. Describe the rotation of the superior mesenteric artery to rotation of the primary intestinal loop.
35. What determines the arrangement of the root of the mesentery?
36. Describe the development of the foramen of Winslow.
37. What part does the hepatic artery play in the creation of the foramen of Winslow?
38. How many lobes has the liver; how many ligaments; how many fissures?
39. Describe the development of the portal system.
40. Describe the vascular system of the liver during the following stages of development; (a) the vitelline stage, (b) placental stage, (c) the portal stage.
41. Name the fissures of the liver.
42. Bound the lobes of the liver.
43. What is the caudate process of the liver; its relation to the foramen epiploicum?
44. What vessels bring venous blood to the liver? What vessel supplies this organ with arterial blood?
45. What is the porta hepatis; what structures does it contain?
46. Describe the portal vein and its tributaries.
47. To what part of the liver does the cystic vein drain?
48. What are the chief causes of pylephlebitis?
49. What is the relation of the portal vein to the neck of the pancreas?
50. Name the chief functions of the liver.
51. Discuss the digestion and absorption of proteins.
52. Discuss the digestion and absorption of sugars and starches.
53. Discuss the digestion and absorption of fats.
54. What is steatorrhea; azotorrhea?

55. To what is the normal dark color of feces due?
56. Describe the typical stools observed with blockage of the pancreatic ducts.
57. What is fat necrosis?
58. How can the scattered nature of patches of fat necrosis be accounted for?
59. What are lacteals? Describe in detail.
60. What is meant by efferent lymph vessels; afferent lymph vessels?
61. What is the thoracic duct; into what does this duct empty?
62. What is chylous ascites; chyliform ascites; Virehow-Troissier gland?
63. What are the chief groups of abdominal lymph nodes?
64. What is the reticulo-endothelial system? What are the Kupffer cells of the liver?
65. What points are to be noted in examining a lymph gland?
66. Classify lymph adenopathies.
67. Describe a typical inflammatory lymphadenoma.
68. Describe a typical syphilitic lymphadenoma.
69. Describe a typical tuberculous lymphadenoma.
70. Describe a typical malignant lymphadenoma.
71. What are the characteristics of primary or essential lymphadenomata?
72. What is Hodgkin's disease; leucemia; granuloma inguinale?
73. Name some of the methods for differentiating between lymphadenomata.
74. Discuss causes of enlargement of inguinal lymph glands.
75. Discuss malignant inguinal lymphadenomata.
76. From what other conditions must enlargement of inguinal lymphatic glands be differentiated?

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## RECONSTRUCTIVE SURGERY IN UNILATERAL PROGRESSIVE FACIAL HEMIHYPERTROPHY\*

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THE problems of the reconstructive surgeon are sometimes of general interest and the fact that Osler's "Practice of Medicine" gives but a single line to the mention of unilateral progressive facial hemihypertrophy urges me to detail an attempt at surgical reconstruction of such a case referred to me by Dr. E. F. Tholen. The condition referred to is a unilateral enlargement of one-half or side of the face including all or a part of the bony as well as the soft structures.

When I first saw the patient (Fig. 1) and made a working diagnosis, I tried to confirm it by a casual search through the textbooks at hand, which proved unsuccessful until a reference in Dana's "Diseases of the Nervous System" brought to light a case with an illustration similar to my patient. Dana referred to his patient as the eleventh reported case. A search of the literature brought numerous references to facial hemiatrophy but very few to unilateral facial hemihypertrophies, the earliest being that of Beck<sup>1</sup> in 1836. I found my interest lay not only in the rarity of the case but in the possibility of surgical reconstruction with cosmetic improvement. The thought of possible recurrence or stimulation of the condition following operation, elicited from the available literature the fact that only one such reported case of a patient had been operated on and that one not for cosmetic purposes, but for relief of pain from the growth of the superior maxillary bone.

Montgomery's<sup>10</sup> case report in 1893 is of interest in that in his article he states: "the interest in these cases lies in their exceeding rarity, it is by the careful reporting of such cases whenever found that some future collaborator may be enabled to draw valuable inferences." I am indebted to him for a list of cases<sup>1-9</sup> preceding his, which from checking the early literature I find to be acceptably accurate and am including in my bibliography for the assistance of tomorrow's collaborators. His case however was not congenital, having first been noticed at ten years of age. The tongue was not hypertrophied but the usual accompanying pigmented nevus was present on the left cheek.

Dana's<sup>11</sup> case was that of "The Giant Wilkins" who came under his observation in the early nineties and who was later reported again by Peter Bassoe<sup>12</sup> who took care of him during his final illness and published the post-mortem findings. The studies of these two men established the condition as an entity by differentiating it from acromegaly. They however called attention to the fact that it sometimes appeared in conjunction with acromegaly and giantism.

Werner's<sup>13</sup> case reported in 1904 was:

A male aged twenty-four with a negative family history and a congenital hypertrophy of the left side of the face. His general condition was normal, and he was of medium size. The hypertrophy included the upper jaw, cheek, lips, lower jaw as well as the teeth, tongue and

\*Read before the Joint Meeting of the San Luis Obispo and Santa Barbara County Medical Societies, at Santa Maria, Calif., July 14, 1930.

tonsil. It appeared as if the anterior half of the skull was formed with a large left side and a smaller right. The left angle of the mouth

hypertrophy, and render it a textbook entity. To this picture of the disease, of which much has been said etiologically



FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

FIG. 1. Facialis unilateral hemihypertrophy at twenty-one years.

FIG. 2. Hemihypertrophy of both soft and bony structures.

FIG. 3. Congenital hypertrophy at three months. Same case as Figs. 1 and 2.

FIG. 4. Progressive enlargement at five years. Same case as Fig. 3.

was drawn downward, so that about 5 mm. of the left half of the lower lip was obscured. On the anterior surface of the neck there was a dark pigmented area which was somewhat elevated, with irregular margins and enlarged papillae, but without increased growth of hair.

It is more than interesting to note that every detail of the foregoing is duplicated in the present reported case (Fig. 2) even to the peculiar incidence of the pigmented nevus on the neck which Werner quotes as an argument against macrosomy developed on the neurotic basis.

Mackay<sup>14</sup> in 1904 in presenting a case of acquired hemihypertrophy lists 19 congenital cases and calls attention to the fact that in all 19 cases the parts affected corresponded exactly to the distribution area of the fifth nerve.

Welt-Kakels<sup>15</sup> in 1914, in discussing her reported case called attention to the hemihypertrophy of the tongue as an evidence of congenitalism.

It would seem that up to the present, there are approximately 25 or so reported cases with enough similar points to give a rather definite clinical picture of congenital facial unilateral progressive hemi-

and pathologically, I would like to add a contribution toward therapy in the form of reconstructive surgical measures which in the following case have proved satisfactory.

My patient is a lad of twenty-one, husky, 6 ft. 3 in. weighing 170 lb., recently graduated from high school, well up in his class, with a desire to teach agronomy in the junior high school. His facial appearance constituted a handicap in dealing with youngsters and he came to me in hopes of benefiting his appearance and aiding his mastication.

His family history is negative. His father is a well-developed man of 6 ft. 1 in. and his mother at the time of his birth was healthy and normal, having in late years developed a chronic arthritis. He had a normal birth but it was noticed that there was a hypertrophy of the left face as shown by his baby picture at three months (Fig. 3). His childhood on the farm was uneventful and his picture at five years of age (Fig. 4) shows a progressive unilateral facial development.

The general physical examination disclosed no abnormalities aside from the facial condition and it was the consensus of familial opinion that there had been "no change in the face for at least five years."

Aside from the special examination reports that follow, the striking points of interest in the left face are the variations from normal.

close and the gums are touching at the posterior portion.

The left mandible seems to slope inward.



FIG. 5.

FIG. 6.

FIG. 5. Showing bony involvement in same case as Fig. 1.  
FIG. 6. Note mandibular overgrowth. Same case as Fig. 2.

The left cheek is of rather firm consistency, does not pit and is about 5 cm. thick and measures 7 cm. larger from the philtrum to the tragus.

There is a pigmented nevus on the left neck some 6 cm. in diameter.



FIG. 7. Mask of face before operation.

The beard is normal on both sides.

The left lips are markedly enlarged and the left corner of the mouth pouting and pendulent with the angle drawn downward.

The mouth opens normally but seems to gap toward the right.

The left tongue is a half larger than the right.

The left upper and lower molars have been removed in an effort to allow the mouth to



FIG. 8. Composite model of jaw.

The left superior maxilla is markedly displaced toward the center line and the palate is very high.

Dr. M. Russell Wilcox kindly examined the eyes and found the vision normal and no evidence of intracranial pressure or sella turcica involvement. The nose interior was normal with the exception of the pushing to the right of the septum. The ears were normal except for a symmetrical enlargement of the left one. The left antrum transilluminated poorly but there was no history of infective activity.

Dr. Wm. D. Napheys reported in his *neurologic examination* as follows: "Lower portion of left side of face much larger than right, soft and bony structures both involved. Lower jaw prognathous and deviates to left. Tongue when protruded deviates to right and left half of same is much larger than right half. Other facial muscles function equally on both sides, as far as trophic asymmetry will permit judgment. There is a slight, fine, rapid tremor of tongue, eyelids and fingers. Romberg's sign not present. No paralysis or paresis of muscles of face or elsewhere over body. Reactions to electric stimulation were not normal and equal on both sides, but were not typical of the reaction of degeneration. There was a slight modal change present, the faradic current did not produce as much contraction when applied to the muscles on the left side as on the right. In contrast to the usual quantitative changes, faradic stimulation of the left facial nerve produced a more marked response on the left side than on the right. There was no qualitative change, in that galvanic stimulation of the



muscle produced an equal response on both sides. There was no polar change present, the negative galvanic irritation of the facial nerve producing a more marked response than the positive on both sides.

There was no sensory change present in either side of the face and the special senses were all normal. No disturbance of superficial or deep reflexes was present. Subject showed a normal mentality and except for a slightly unusual response to electric stimulation of the face, which might be interpreted as an anomalous partial reaction of degeneration and hemifacial hypertrophy indicative of trophic change, the neurologic findings were negative."

From an x-ray standpoint there was much to be learned (Figs. 5 and 6). The sella turcica was normal in size and shape according to Dr. Benj. H. Sherman the radiologist. The skull was normal while large, with the exception of the left lower face. The hypertrophy involved the left mandible from the midline showing a bony structure of normal density but twice as large as the right side in all dimensions except the longitudinal. The left lower front teeth were somewhat enlarged and there was an exostosis forward to the left of the midline of the mandible. The left upper and lower back teeth had all been previously removed and an alveolectomy performed with good results. The left superior maxilla was pushed inward to the extent of making practically a straight line from the midline at the incisor teeth to the molars, such distortion evidently having been caused by the overgrowth of the mandible. The left antrum was cloudy. The zygoma and orbit were normal. The nasal bones and the nasal process of the superior maxilla were pushed to the right giving a distortion to the right of the septum and entire nose.

The laboratory findings were of interest in that they showed no marked abnormalities except a rather high hemoglobin of 1.24 (Sahli) with a 1.1 plus color index. The pituitary hormone in the blood as checked by R. S. Willard, Ph.D., was 13 mg. per 100 c.c. as against a normal of 11.4. Following are the reports of Dr. V. L. Andrews of the Hollywood Hospital:

#### Blood:

Leucocytes.....	9,000
Polymorphonuclears, per cent.....	69
Erythrocytes.....	5,200,000

#### Blood Chemistry:

N. P. N.....	40.5
Uric acid.....	3.0
Sodium chlorides.....	220.0
Sugar.....	67.8
Sodium.....	1,075.5
Calcium.....	20.1
Potassium.....	18.2
Magnesium.....	3.1

#### Phosphorus:

Inorganic.....	2.247
Inorganic and hydrolyzable.....	1.559
Acid solution.....	7.410
Total.....	11.216

#### Fats:

Cholesterol.....	250.
Lecithin.....	200.
Fatty acids.....	25.
Neutral fats.....	0.
Total.....	475.

#### Amino-Acids:

.....	8.4
Enzymes:	
Pepsin.....	.0
Trypsin.....	.0
Lipase.....	.0001
Amylopsin.....	.0001

#### Urine:

Negative throughout

#### Basal Metabolism Rate:

Normal to less than  $\frac{1}{2}$  per cent  
T. 97.2 P. 72 R. 18

#### Wassermann Test Negative:

The question then of differential diagnosis involves, the ruling out of hemiatrophy because of the absence of atrophic changes on the right or smaller side. Acute swellings need not be considered on account of the history. Acromegaly is excluded by the characteristic general symptoms being absent; hemangioma, by persistent size on change of posture and character of cheek tissue; partial macrosomy, by the history, leontiasis ossea, by absence of typical bony deformity. The involvement of the soft parts speaks against diffuse hyperostosis.

The hemilateral enlargement of the bony as well as the soft structures, with an authenticated history from birth, with the elimination of possible conflicting diagnoses, leaves the diagnosis of congenital unilateral progressive facial hemihypertrophy with possibly a mild giantism, the title of choice.

It was the opinion of the consultants that there was no contraindication for operation except lack of precedent and preparations were made accordingly.

A preliminary plaster mask (Fig. 7) of the face and a composite model of the jaw (Fig. 8).

from actual measurements revealed a ridge of bone on the left lower edge of the mandible some 12 cm. in length and from 1 to 15 mm. larger than the right side. Under tracheal intubation and colonic-ether anesthesia, a semilunar incision was made from a point 3 cm. to the right of the midline of the mandible and 3 cm. posterior to the point of the chin to a point opposite the auricular canal. The skin was freed and elevated to the lip border and as far forward as the zygoma. A large amount of hypertrophic fatty tissue interspersed with connective tissue bands was removed from the cheek. The excess bone was sectioned at the lower edge of the mandible with a rotating electric saw and the facial skin brought down and refitted over the face.

It was found that the new closure would entail the removal of an elliptical strip of skin some 15 cm. in length and 4 cm. at its greatest width. Rubber-dam drains were employed and the excision closed by interrupted sutures. Pressure and icebags allowed healing by primary intention and there was an early establishment of cutaneous sensation (Fig. 9). The pathologist's report on the section of bone removed was that it compared favorably with normal bony tissue. The skin and fatty tissue removed did not show any abnormalities. The section of epithelium was of normal thickness.

The parotid was enlarged and the intraoral opening of Stenson's duct was somewhat forward and lower than ordinary. The left mental foramen of the mandible instead of being opposite the first and second lower bicuspid appeared at the point opposite and below the second molar. The dental canal was represented by a groove running along the canal's

usual bed and lying in it, the mandibular dental branch (which was of necessity sectioned) measuring 5 mm. in diameter.

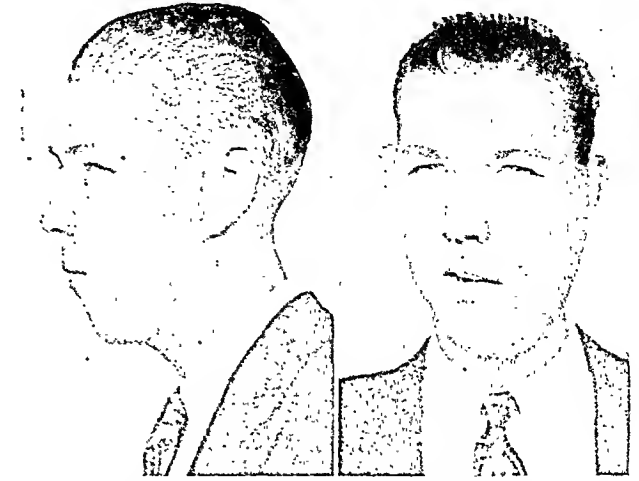


FIG. 9. Postoperative, sixty days.

FIG. 10. Postoperative, six months.

Three months later the exostosis of the incisor area was removed intraorally and a portion of the upper lip resected. Dr. Leigh Faul constructed the necessary upper and lower plates and the patient was allowed to proceed with his instructionship. There has been some recurrence of the fatty deposit in the left cheek (Fig. 10) and the patient has gained in weight. I think that sea sponge pressure over the cheek for a period directly postoperatively would have been a help. There has been no recurrence of the bony growth and the jaw has healed smoothly.

With this experience I can see no reason why similar cases should not be operated once they have reached maturity.

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# HOW WAVES GO DOWN THE BOWEL\*

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IN view of the fact that conduction along the muscular wall of the intestine is one of the most important functions in the body it is all the more remarkable that today practically nothing is known about it. The main reason for this ignorance is that thirty years ago physiologists throughout the world accepted unanimously and without reservation a misquotation and a misunderstanding of the statements of W. M. Bayliss and E. S. Starling. These men observed that if they cut the vagus and splanchnic nerves of a dog and then purged and anesthetized him, stimulation at a point on the small bowel would *sometimes* cause contraction orad and relaxation caudad. They had difficulty in showing this "reflex" in the cat, and they were practically unable to show it in the rabbit.

In spite of the fact that the few men who later attempted to confirm these observations had difficulty in doing so, and in spite of the fact that later Cannon warned the medical world that this "reflex" probably had nothing to do with several of the most important phases of gastrointestinal peristalsis, the writers of textbooks promptly brushed away all doubts; they quoted Bayliss' and Starling's principal statement without its important restricting clause, and as a result the "law of the intestine" became one of the foundation stones of physiology. About which there appeared to be no further question. The fact that the phenomenon was inconstant and hard to elicit, that it was hard to elicit in the cat and almost impossible to elicit in the rabbit, that it was present only in denervated and purged bowel, and that it could be made with the bowel of man seemed to be it, so that was ignored and forgotten, and students were taught and

are being taught and will doubtless be taught for another fifty years that in all normal animals all stimuli produce contraction above and relaxation below, and this is why waves go down the bowel.

Actually, if one takes a normal rabbit or a rabbit with vagus and splanchnic nerves cut, and stimulates the bowel with an electric current, one gets almost always contraction at the point stimulated and also above and below. Occasionally there will be seen a momentary inhibition but, as Bayliss and Starling found, this inhibition will sometimes appear above as well as below the point stimulated.

The stimulus appears to act much as a stone does when it is thrown into a pond; from the local disturbance ripples spread out on all sides. In the bowel of the rabbit a wavelet of some kind ordinarily runs orad for a distance of from 3 to 15 cm., and caudad for a distance of from 3 to 20 cm. It almost always goes farther caudad than orad, and it seems to travel a little faster caudad than orad.

There is considerable evidence to show that this wavelet travels along the nerve fibers in Auerbach's plexus. Thus, if one makes a circular cut through the muscle down to the mucous membrane and allows it to heal there will later be no sign of conduction of electrically produced wavelets past the scar. Peristaltic rushes will easily jump the gap because, as I showed years ago, they push a column of fluid ahead of them, and the distention produced by this column causes a new rush to start on the other side of the obstruction. One can actually cut the bowel in two and join the ends with a piece of glass tubing without interrupting in the slightest the progress of peristaltic rushes down the bowel. If it were not for this mechanism, the maintenance of life after end-to-end or

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side-to-side anastomoses of the bowel would probably be impossible.

Besides the impulses which travel slowly through the neurones in Auerbach's plexus there are others which travel rapidly by way of long nerve paths in the mesentery or in the bowel. My records of intestinal activity, made simultaneously from many parts of the bowel, show that often when a peristaltic wave starts on its way down the duodenum the lower ileum will almost immediately begin to contract so as to keep the intestinal contents from going on too rapidly into the colon. Although I have not been able to demonstrate it in my records I suspect that there is also some coördinating influence which speeds ahead of the rush wave and smooths the way for it because the excised bowel behaves so differently from the intact bowel when one injects fluids into the orad end. In the living rabbit, such fluid, even in the absence of waves, will seep rapidly caudad, while in the excised bowel it can be forced through only slowly and with difficulty. Similarly if one bathes a loop of bowel from a living animal in a weak solution of nicotine the rhythmic contractions which tend normally to spread caudad become incoördinated, the muscle shortens here, there, and everywhere about the same time, and the bowel takes on the appearance of a string of beads.

There is much evidence now to show that, at least in the chicken, Auerbach's plexus is made up primarily of a chain of neurones each about 10 cm. long. Between them, perhaps, are valve-like synapses much like those in the central nervous system, synapses which make it easy for impulses to travel in one direction but almost impossible to travel in the other. These nerves in the bowel are different from those elsewhere in the body; they probably have a very slow rate of metabolism because they conduct so sluggishly (about 5 cm. a second) and because they can live so long after the circulation is shut off. The nerve cells in the brain and spinal cord are destroyed or irrepa-

rably injured after ten minutes of anoxemia but, as Cannon and Burket have shown, the nerve cells in Auerbach's plexus will survive periods of anoxemia lasting three hours or more. Experiments which my assistants and I are now performing indicate that what Cannon and Burket found in the cat is true also for the rabbit, and the surgeon here has an explanation for the fact that bowel freed from incarceration in hernial openings will often survive and regain its function after surprisingly long periods of strangulation.

One of my reasons for deciding to spend several years in the study of conduction in the bowel and in an attempt to analyze the structure of Auerbach's plexus was my desire to understand something of the mechanism underlying certain types of dynamic ileus. Every so often a surgeon who has had to open an abdomen on account of signs and symptoms of intestinal obstruction will find at the caudad end of a distended loop a ring of muscle which, except for the fact that it remains contracted, appears to be perfectly normal. What has gone wrong? Occasionally such rings will relax at the time of operation but sometimes they do not, and the only way in which to cure the patient is to excise the contracted region. A similar type of contraction seems to account also for the obstruction in many cases of Hirschsprung's disease.

Although as yet I have little evidence to back up my theory it has long seemed probable to me that these contraction rings must be due to a loss of function in the neurones in Auerbach's plexus which are connected with the muscle fibers. As Nolf has pointed out, there is considerable physiologic and anatomic evidence to show that Auerbach's plexus consists of two types of nerve cells: one group perhaps concerned with the maintenance of good conduction along the bowel, and the other group connected with the muscle fibers. Besides those two sets of neurones, with their axones and dendrites, there are, in Auerbach's plexus, innumerable fibers of

vagal and splanchnic origin. That the vagal fibers are of little importance in conduction was shown recently by Hosoi and me. We cut the vagi, allowed time for degeneration, and then found that, except in the lower part of the ileum, conduction was unimpaired. Degenerative section of the splanchnic nerves interfered considerably with the conduction of electrically produced disturbances, but the rush waves continued to travel normally down the bowel, and some of the animals lived and gained weight.

Incidentally, we saw no sign of that antagonism or balance between the vagus and splanchnic nerves which is so dear to the heart of medical theorists. Cannon saw no sign of it during the years in which he was removing the sympathetic nervous system from cats. Unfortunately for the theories of clinical writers the statement found in all textbooks to the effect that the vagus is the motor nerve for the bowel and the sympathetic the inhibitor is wrong. As usual with such clear-cut statements, it contains a grain of truth, but anyone who will take the trouble to perform a few experiments or to look through the literature will soon see that the problem is not so simple. The nerves are bundles of all sorts of fibers and for this and other reasons the effects obtained when they are stimulated are complicated and variable.

One can destroy the conducting function of the first group of neurones in Auerbach's plexus either by giving nicotine or by shutting off the supply of oxygen, but it is hard to know how to destroy the function of the second group without at the same time injuring the muscle. At first sight it should be easy because we know that the excised muscle will beat rhythmically and normally after it has been kept for four or five days in an ice box, and it does not seem probable that even the remarkably hardy nerve cells of the myenteric plexus could live that long. Unfortunately we do not know yet how long they can retain their functions when the tissue is

kept cool, and it may be that under these circumstances they can live for several days.

At present I am trying to find a period of anoxemia long enough to destroy the nerve cells but not long enough to destroy the muscle. I believe it can be found because surgeons occasionally discover that a loop of bowel which has been strangulated for a long time, or which has lost its connection with the mesentery, will survive, only to contract later to a hard narrow tube. My reason for believing that this phenomenon is due to the loss by the muscle of its immediate nerve supply is that experiments on lower forms of life have shown that such a loss will produce a form of spastic paralysis: the muscle separated from its ganglion cells contracts down into a hard knot and stays that way.

From what is known now of Auerbach's plexus it seems probable that certain forms of paralytic ileus might easily be due to the deleterious effect of some toxin or some inhibiting influence acting on the very vulnerable synapses between the first group of conducting neurones. Such an injury would leave the segmenting activity of the bowel unharmed but would perhaps put a stop to the peristaltic rushes.

I regret that in this short paper I have not answered the questions with which I started but if perhaps I have shaken the faith of my readers in some of the statements that have heretofore lulled them into a sense of false security, and if I have stimulated them to think more about these problems of intestinal function I will have done something of what the Program Committee asked me to do.

I would strongly recommend to all those who think they know something about the innervation of the bowel that they read Van Campenhout's recent review of the attempts that embryologists have made to clarify the problem. At present there are seven who claim that the nerves of the bowel arise from the mesoderm; four are sure that these nerves come from vagal

primordia, and fourteen are equally sure that they are of sympathetic origin. In this world of science it seems as if only the writer of textbooks can arrive easily and promptly at the truth.

#### SUMMARY

Faradic stimulation of the small bowel of the rabbit causes a disturbance to spread out from 3 to 20 cm. orad and caudad. As a rule these wavelets travel slightly farther and faster caudad than orad and they almost always cause contraction of the muscle. There is rarely any sign of Bayliss' and Starling's law in the bowel of the rabbit.

There is considerable evidence to show that conduction in the bowel takes place by way of neurones in Auerbach's plexus. The synapses between these neurones are probably valve-like and favor conduction in the caudad direction; they appear to be highly susceptible to anoxemia because in the rabbit peristaltic rushes disappear immediately after the death of the animal. They are susceptible also to the action of nicotine.

The nerve cells are remarkably resistant to anoxemia as shown by the fact that in the cat they do not seem to lose their function when the circulation is shut off for five hours. Certain forms of paralytic ileus may perhaps be due to a blockage by toxins or by nervous inhibition of the synapses between the conducting neurones in Auerbach's plexus. Tonic contraction rings which sometimes produce intestinal obstruction may well be produced by a loss of function in another group of neurones which presumably are attached directly to the muscle.

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# DIET AFTER OPERATIONS ON THE STOMACH\*

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THE average surgeon, after performing an operation upon the stomach, gastroenterostomy, partial or subtotal gastrectomy, pylorotomy or any other procedure, will leave orders for the patient to have nothing by mouth for twenty-four or forty-eight hours, or if liberal in regard to feedings, will allow sips of water or cracked ice for a day or two and then add broths, tea or lemonade for a few days, followed by a rather rapid increase to a too liberal diet. Often the patient is discharged from the hospital with permission to eat everything. The bad results of this irrational and careless method of treatment are constantly being encountered, and it is time to suggest a remedy.

In order to rationalize postoperative diets it is necessary to consider the conditions that present themselves. As ruthless surgery for ordinary small peptic ulcers is gradually being abandoned by conservative surgeons, it means that the candidate for operation has either a carcinoma or one of the complications of an ulcer: stenosis, perforation or a large indurated ulcer which has bled and requires operation. The patient is therefore, as a rule, a poor operative risk. In partially obstructive cases, preoperative feeding of small quantities of concentrated foods, milk, cream and lactose mixtures, at short intervals, will often, in a week or ten days, transform an exceedingly bad risk into a fairly good one. Rectal feedings of glucose and alcohol, and subcutaneous or intravenous injections of saline or glucose, will further help to improve the operative risk. Nevertheless the operative patient is usually much under weight, has been more or less starved for some time, and presents a picture of dehydration and even acidosis. His gastrointestinal tract, having become

unaccustomed to propelling normal quantities of content, is in a condition where postoperative ileus is to be anticipated. The Murphy drip, while of inestimable value in these cases, is not always sufficient to save life, and lavage, enemas, stupes and medication are often not of use in preventing or combating ileus.

The ideal gastric operation is one done under local, block or spinal anesthesia, avoiding the shock, dehydration and postoperative starvation period attendant upon general anesthesia. The ideal postoperative treatment would consist of measures to prevent or treat shock, the early administration of fluids to overcome the already existent dehydration, and the early ingestion of material which would stimulate gastrointestinal motility, thus avoiding distressing distention or ileus. Shock has always been combated by suitable medication and by application of heat externally. The Murphy drip, whether of saline or glucose, when successfully administered, has added unbelievable amounts of fluid to the patient's organism; but how often, unless a special nurse is constantly on the alert, do we not find the fluid in the bed, the patient saturated and the tube causing annoyance, restlessness or even pain?

In an effort to institute early feedings after operation, the writer, twelve years ago<sup>1</sup> reported the successful administration of peptonized milk, cream, dextrose and alcohol mixtures through a Rehfuß tube which had been placed in the patient's stomach before operation, and which had been pushed well into the intestine by the surgeon at the time of operation. Feeding through tube was commenced while the abdominal wound was still open showed that 250 mls of a feeding mixture such as mentioned previously, would result in prompt peristalsis and the rapid passage

\* Read before meeting of American Gastro-Enterological Association, May 6, 1930.

of the food through the intestinal tract, even when the patient was under deep general anesthesia. Spontaneous bowel movements occurred within two days after operation, and these patients were generally in remarkably fine condition. Shock, dehydration and postoperative distention were practically always avoided. During the period when this procedure was thus being successfully used, it was found in one case that while the tube had been drawn back early into the stomach by postoperative vomiting, the administration of 250 mls of milk, cream and dextrose mixture every two hours through the tube directly into the stomach had been as productive of good results as the jejunal feedings had been in the other cases. This suggested the desirability of giving feedings by mouth immediately after operation, thus avoiding the trouble, trauma and possibility of infection incident to the opening of the stomach when the surgeon placed the tip of the tube well down in the jejunum. However, it was very difficult to persuade surgeons that immediate oral feedings would be safe. It was pointed out that if the surgeon feared leakage from his wound, the gastric juice which the stomach would inevitably begin to secrete after the operation, would of itself not only furnish a sufficient quantity of fluid to be dangerous from the leakage standpoint, but its digestive effect might possibly be deleterious to the suture material and the new scar. On the other hand, the surgeons pointed out that in the first few days after operation a wound could not stand much strain and that eight or nine days afterward the catgut is practically absorbed, which might cause some loss of strength in the wound. In more recent years the researches into wound healing by Harvey and Howes at Yale Medical School,<sup>2,3,4</sup> have shown that during the first three or four days clean wounds of the stomach wall have almost no tensile strength and that cohesion depends almost entirely on the sutures. After this quiescent period strength increases very rapidly,

until at ten days it has almost reached its maximum, and at twelve or thirteen days the wound may be considered to be perfectly healed. The process of healing has been shown to be aided and accelerated by the presence of protein in the stomach lumen.

About eleven years ago we devised a system of postoperative feedings, which has been called the Long Island College Hospital Gastroenterostomy Diet, and which, with occasional slight modifications, has gradually been adopted by our surgical staff, until now it is practically a routine for postoperative gastric cases. This routine is as follows:

#### DIET AFTER OPERATIONS ON THE STOMACH

No feedings to be given when patient is asleep.

No ice, water or other drinks to be given. Lips may be moistened.

Mineral oil,  $\frac{1}{2}$  oz. to be given on second night, and every night thereafter.

##### First Day:

Feedings every two hours as follows:

Beginning on recovery from anesthetic or three hours after return to ward after operation under local anesthesia.

Gelatin solution: 4 oz.

##### Second Day:

Feedings every one and one-half hours as follows:

Gelatin solution: 4 oz.

Gruel mixture No. 1: 4 oz. Alternating

##### Third Day:

Feedings every one and one-half hours as follows:

Gelatin solution: 5 oz.

Gruel mixture No. 1: 5 oz. Alternating

##### Fourth Day and Fifth Day Feedings, every two hours.

Gelatin solution: 6 oz.

Gruel mixture No. 2: 6 oz. Alternating

##### Sixth and Seventh Days:

Gelatin and gruel, alternating as on previous days, but add to 3 gruel feedings in day any one of following:

1 soft-poached egg,  
3 oz. cereal,  
custard

##### Eighth, Ninth and Tenth Days:

Gruel mixture No. 2, 6 oz. every three hours, adding to each feeding any *two* of the following:

3 oz. cereal and cream, 1 soft egg  
custard or jello, 2 oz.

##### Eleventh Day and thereafter:

Long Island College Hospital Ulcer Diet

The formulae mentioned in the diet are as follows:



## FORMULAE FOR FEEDINGS AFTER OPERATION

	Ounces	Grams	Calories
Gelatin solution:			
Gelatin.....	1	30	110
Lactose.....	3	90	360
Juice of 1 orange.....	..	....	40
Water.....	32	1000	
Gruel mixture No. 1:			
Cereal gruel (Oatmeal, barley or cornmeal).....	16	500	125
Milk.....	14	420	280
Cream.....	4	120	480
Lactose.....	3	90	360
Gruel mixture No. 2:			
Cereal gruel (Oatmeal, barley or cornmeal).....	12	350	100
Milk.....	32	1000	640
Cream.....	4	120	480
Lactose.....	4	120	480

As will be seen from a study of the formulae and the quantity of frequency of the feedings as suggested before, patients on this diet receive in the neighborhood of 600 to 700 calories during the first day, 1200 to 1400 calories the second day, 1400 to 1600 calories the third day, and by the eleventh day are getting 2500 to 3000 calories in twenty-four hours. The quantities of solutions given are not so great as to cause undue tension at the site of operation, are easily taken and promptly pass on beyond the stomach. The ability to take food encourages the patient and improves his morale. The food stimulates the salivary glands, and the amount of liquid given by mouth obviates the necessity for its rectal or subcutaneous administration. All the formulae are soothing to the irritated gastric mucosa and to the wound, all contain some of the protein which Harvey has found to encourage wound healing, all combine readily with gastric juice without overstimulating its production. In addition, the gelatin is a coagulant when applied to bleeding surfaces. With the use of this postoperative diet the improvement in the general condition of the patient is marked, visitors often finding it difficult to believe that a patient has been operated upon the previous day. Spontaneous bowel movements almost invariably occur on the second or third day, even without the

administration of mineral oil. Occasionally there is a tendency to diarrhea, due to the large amount of lactose being taken by the patient, and this tendency can be overcome by decreasing or entirely eliminating the sugar. Some patients cannot take the quantities suggested in our diet table, and the size of the feedings may have to be reduced for them. Patients exhibiting allergic reactions from the ingestion of milk or eggs will require substitution of other proteins for these. So rarely does any considerable distention occur, that it is almost unnecessary to mention any treatment for it. A little pituitary extract might occasionally be of use where distention seems to be threatened. If spontaneous bowel evacuation does not occur, a retention oil enema on the third night after operation, if necessary followed by a small soap-suds enema the next morning will initiate subsequent regular daily bowel movements. On the eleventh day after operation, as indicated in the outline given, the patient is put on the Long Island College Hospital Ulcer Diet (shown later)

## LONG ISLAND COLLEGE HOSPITAL ULCER DIET

## Breakfast:

Milk, 8 oz. with cream if desired  
Cereal, 5 oz. with milk or cream  
Egg, 1 soft-boiled or poached  
Bread or toast with butter, 2 slices  
Fruit juice or stewed fruit (at end of meal).

## Mid-morning:

Milk, 8 oz. cream,  $\frac{1}{2}$  oz. lactose,  $\frac{1}{2}$  oz. with cocoa if desired, always with crackers, toast, bread or cake.

## Luncheon:

Milk, 8 oz.  
Baked or mashed potato or plain spaghetti  
Egg, 1 soft-boiled or poached or cream cheese  
Bread and butter, 2 slices  
Pudding, custard, gelatin, ice cream, or stewed fruit.

## Mid-afternoon:

Same as mid-morning.

## Supper:

Same as breakfast or luncheon.

At bedtime and during night every two and one-half hours, if awake: same as at mid-morning:

Olive oil,  $\frac{1}{2}$  oz. three times a day before meals  
Mineral oil,  $\frac{1}{2}$  oz. at bedtime  
Water: ad libitum.

which should be continued for a period of three or four weeks, when gradually there

are added all kinds of vegetables and fruits, and an increasing variety of other foods. It must be remembered that in most cases there is no pyloric sphincter action after operation, that food entering the stomach is rapidly passed into an intestine not naturally fitted to receive such unchanged food and that often more or less serious symptoms result from the ingestion of food which is not thoroughly cooked, finely divided and thoroughly masticated. Meat has been found to be particularly prone to make trouble, and should not be added to the diet for at least three or four months after operation, and then very cautiously. Fortunately, in most cases the gastrointestinal tract eventually adapts itself to the new conditions, and then these patients can eat practically normal diets.

#### CONCLUSIONS

1. Most existent postoperative diets are irrational and add to the danger of opera-

tion, to the discomfort of the patient and to the length of the period of convalescence.

2. Early feedings are desirable to encourage the patient and to improve his general condition, to promote wound healing, and to stimulate normal gastrointestinal peristalsis.

3. Feedings of gelatin solution and milk and gruel mixtures are soothing, acid binding and coagulant, and are therefore desirable.

4. Careful dietetic care for several months after operation will prevent discomfort to the patient and complications in his convalescence.

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# ROENTGENOLOGICAL STUDY OF THE SUPERIOR AND POSTERIOR MEDIASTINUM\*

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IN a previous communication<sup>1</sup> our study was confined to the soft structures of the neck. In the present paper we shall deal chiefly with the structures of the superior and posterior mediastinum.

It is our experience, based on a large number of examinations, that no study of the superior and posterior mediastinum is complete unless both the anteroposterior and lateral views are made. Of the two the lateral view often renders more valuable information than the anteroposterior view. In the latter several dense structures such as the sternum, spine, heart, and great blood vessels are superimposed, thus obscuring to more or less degree the soft structures of the mediastinum.

We also find that a true lateral view is of greater value than the oblique view. This is due to the fact that a knowledge of the normal relationship between the various structures in a true anteroposterior and lateral positions is more readily acquired. Thus a deviation from the normal in the relationship of the structures is more easily recognized.

The mediastinum is that portion of the chest which is not occupied by the lungs and pleurae. It is bounded in the front by the sternum and behind by the dorsal spine. The lateral boundaries are formed by the pleural sacs. The mediastinum is divided into a superior and an inferior portion by an imaginary plane which corresponds to a horizontal line drawn from the lower part of the body of the fourth dorsal vertebra to the junction between the manubrium and the gladiolus. The inferior portion is subdivided by the anterior and posterior layers of the pericardium into an anterior, middle, and

posterior mediastinum. The anterior mediastinum is in front of the pericardium. The middle mediastinum is within the pericardial sac, and the posterior mediastinum is behind the pericardium and in front of the dorsal vertebrae. In this communication we are interested in the roentgenological consideration of the superior and posterior mediastinum.

The position of the mediastinal structures is essentially due to the equilibrium between the two pleural cavities and the position of the diaphragm. Any change of the position of the diaphragm or any disturbance of the equality of pressure between the two pleural cavities will produce a dislocation of the mediastinal structures. Both local or general causes may be responsible for a change in the position of any of the structures. The local causes will receive our special attention and the structures dealt with will be the trachea, esophagus and aorta.

The position of the trachea, esophagus and aorta as revealed in the anteroposterior view is familiar to all roentgenologists. Any deviation of these structures from their normal course in a lateral direction and the significance which that implies is fully appreciated by all. However, the significance of the exact position of these structures as seen in the lateral view and their deviations in the anteroposterior direction is very much less understood by the average student of roentgenology of the thorax. We shall, therefore, make a detailed description of these structures in the following few paragraphs.

In the lateral view of the thorax, the trachea (Fig. 1 A and B) is recognized on the roentgenogram by its greater transparency in the shape of a narrow column

<sup>1</sup> *Am. J. Roentgenol & Rad. Therapy*, 20: 208-212, 1928.

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which bisects the superior mediastinum into two almost equal parts. The anterior part is in front of the trachea and is

pulmonary artery there is often seen a ring-like shadow due to the origin of the major branches of the bronchi. In front

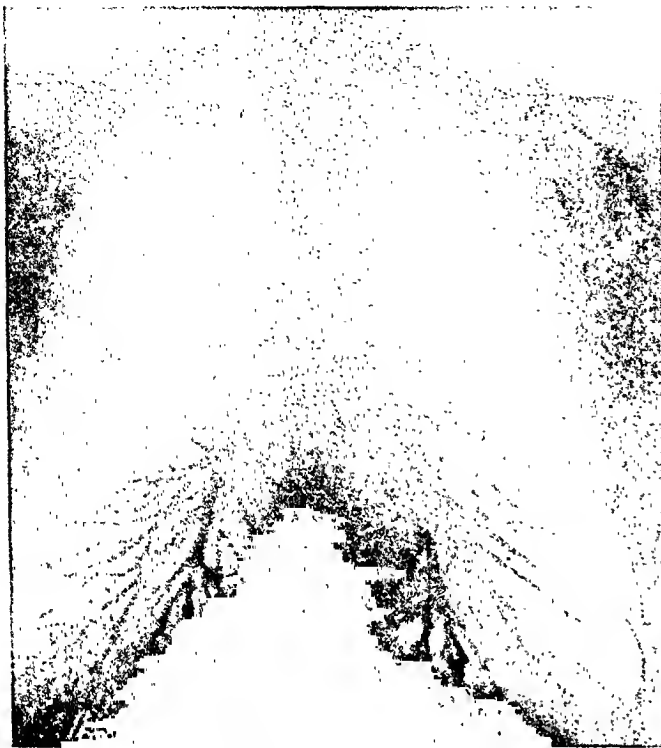


FIG. 1 A. Anterior view. Trachea and bronchi injected with lipiodol. Notice close relationship which exists between trachea on right and arch of aorta on left.



FIG. 1 B. Lateral view. Trachea bisects superior mediastinum into two equal parts. Notice its crossing of arch of aorta. Below arch, trachea is in front of descending aorta.

bounded in front by the sternum. The posterior part is behind the trachea and is bounded behind by the dorsal vertebrae. The width of the trachea varies with the age and habitus of the individual. It is usually wider in broad-chested individuals and narrower in individuals of slender build. Occasionally the tracheal rings are readily made out. The course of the trachea from above downward is usually straight with a slight inclination toward the spine. Above, the trachea is continuous with the cervical portion through the superior aperture of the thorax. Below, the trachea is crossed on the left side by the arch of the aorta and below the arch by the pulmonary artery. These vessels obscure the trachea to a greater or lesser degree depending upon the condition of their walls. In case of dilatation of the aorta the trachea may be found displaced to the right. This is best observed in the anteroposterior view. Below the



FIG. 2. Lateral view. Esophageal diverticulum displacing trachea forward.



FIG. 3. Anterior view. Large esophageal diverticulum resting upon arch of aorta.



FIG. 4. Lateral view. Forward displacement of trachea by retrotracheal goiter.



FIG. 5. Lateral view. Forward displacement of trachea by dilated esophagus. Contraction of esophagus below arch is due to peristaltic wave.



FIG. 6. Lateral view. Carcinoma of esophagus displacing trachea forward.

of the trachea and above the arch of the aorta there is an area of relatively greater density. Its course is parallel to the trachea and its width is about the same as that of the trachea and is due to the blood vessels arising from the aorta and the veins entering the heart. In front of this area the region is more transparent, which is due to the apices of the lungs.

Under abnormal conditions the trachea is often found to be displaced forward as a result of the presence of esophageal diverticula (Figs. 2, 3). Retrotracheal goiter can only be recognized in the lateral view (Fig. 4) by showing the forward displacement of the trachea. In the anterior view it is impossible to determine its true position. The knowledge of the true position of a goiter enables the surgeon to plan the operation accordingly. Forward displacement of the trachea may result from dilatation of the esophagus (Fig. 5), but this is usually of a temporary nature and depends upon the presence of food above the obstruction. However, there may be permanent displacement as a result of a large tumor of the esophagus (Fig. 6). The distance between the spine and trachea indicates the size of the tumor. In this case the walls of the trachea are not involved but only displaced. Occasionally, in addition to the forward displacement there is also narrowing of the lumen of the trachea as well as distortion of its wall (Fig. 7). The subject of this illustration complained more of dyspnea than of dysphagia. An interesting case of forward displacement of the trachea as a result of retrotracheal tumor due to metastasis is represented by Figure 8. This patient complained of difficulty in breathing. The anterior view failed to show anything abnormal in the chest. The lateral view immediately determined the true cause of the difficulty.

Fistulous communication between the trachea and esophagus is best demonstrated in the lateral view as shown in a case of carcinoma of the esophagus illustrated in Figure 9. The greatest usefulness

of the lateral view, we find, is in cases of aneurysm. As a rule an aneurysm is represented by a dense shadow in the anterior



FIG. 7. Lateral view. Carcinoma of esophagus with forward displacement of trachea and distortion of posterior wall of trachea.

view of the superior mediastinum. Its exact origin and its relation to the other mediastinal structures are impossible to determine in this view alone. However, by studying both the anterior and lateral views it is possible to come to a definite conclusion. The anterior view (Fig. 10 A) shows a large circumscribed shadow above the arch of the aorta. In the lateral view (Fig. 10 B) the shadow occupies the posterior portion of the superior mediastinum. The trachea is displaced forward. Evidently the aneurysm is originating from that part of the aorta which is behind the trachea, namely, the upper end of the descending aorta. Postmortem examination of this case confirmed the x-ray finding. The next case (Figs. 11 A and B) is just the opposite. The anterior view also shows a dense shadow occupying the superior mediastinum, but the lateral view reveals posterior displacement of the trachea with the



FIG. 8. Lateral view. Forward displacement of trachea and depression of esophagus by metastatic tumor in superior mediastinum.



FIG. 9. Lateral view. Tracheoesophageal fistula.

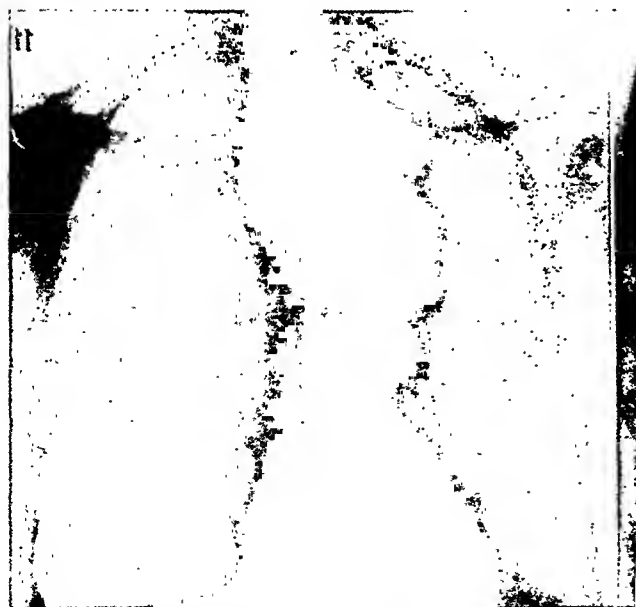


FIG. 10 A. Anterior view. Large circumscribed shadow occupying region of superior mediastinum.

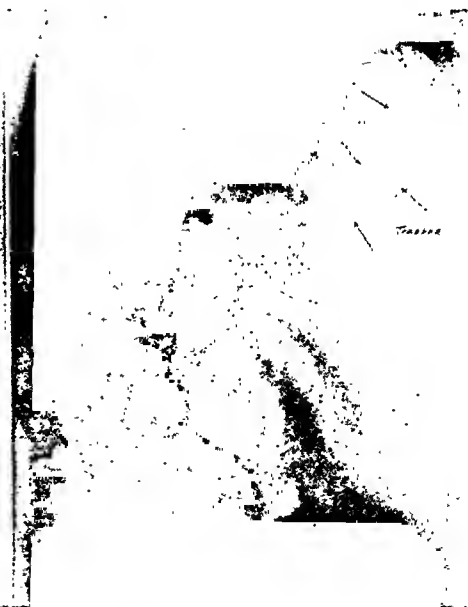


FIG. 10 B. Lateral view. Shadow is behind trachea, which is displaced forward. Evidently, if an aneurysm, it must originate from posterior end of arch or descending aorta. Postmortem examination confirmed this finding.

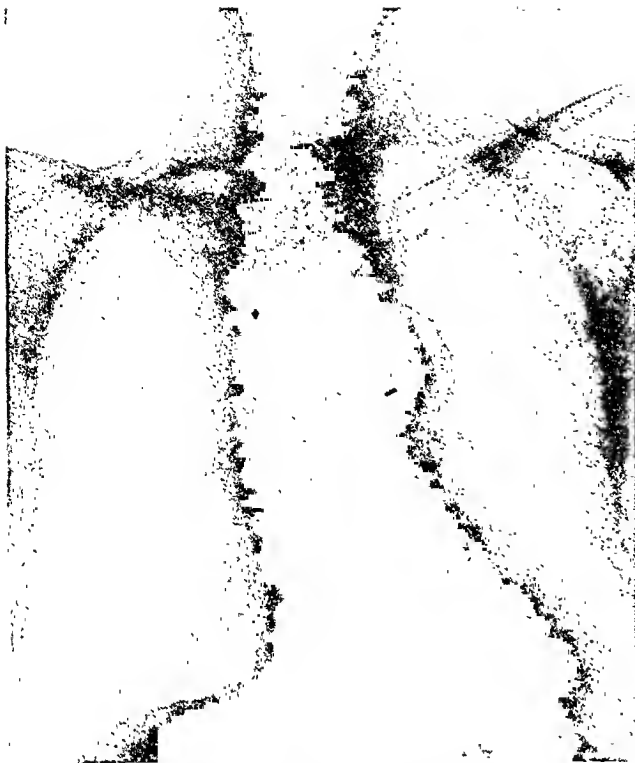


FIG. 11 A. Anterior view. Large shadow occupying region of superior mediastinum.



FIG. 11 B. Lateral view. Shadow is in front of trachea. Latter is displaced backwards. Evidently, if an aneurysm, it must originate from ascending aorta.



FIG. 12 A. Anterior view. Aorta shows moderate dilatation of arch.



FIG. 12 B. Lateral view. Dilatation of arch is confined to inferior surface. Trachea is depressed and displaced forward. Confirmed by postmortem.





FIG. 13 A. Anterior view. Large sharply defined shadow extending from arch of aorta to left.



FIG. 13 B. Lateral view. Entire course of thoracic aorta is markedly dilated and is overlapping dorsal vertebrae. Confirmed by postmortem examination.

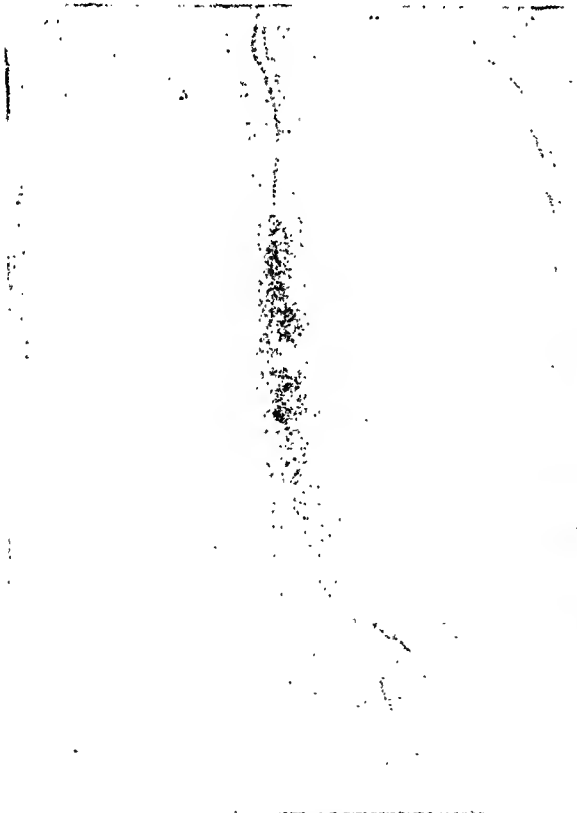


FIG. 14 A. Anterior view. Position of esophagus in front of dorsal spine.



FIG. 14 B. Lateral view. In region of superior mediastinum trachea is in front of esophagus. Below arch of aorta esophagus is in front of descending aorta and behind heart.



FIG. 15. Lateral view. Upper end of esophagus is displaced forward by enlarged gland.



FIG. 16. Lateral view. Compression of esophagus as result of enlarged heart.



FIG. 17. Lateral view. Compression of lower end of esophagus by left ventricular hypertrophy.



FIG. 18. Lateral view. Esophageal distortion as result of diaphragmatic hernia.



FIG. 19. Lateral view. Esophageal perforation into posterior mediastinal structures due to carcinoma.



FIG. 20. Lateral view. Benign esophageal stricture in woman, aged twenty-four. No history of injury. Esophagoscopy examination and subsequent treatment confirmed benign nature of lesion.



FIG. 21. Lateral view. Esophageal stricture at cardiac end of esophagus. Benign in origin. Transparent area is due to plug of food.



FIG. 22. Lateral view. Carcinoma of esophagus below middle third.

density occupying the anterior half of the superior mediastinum. Evidently its origin must be the ascending or anterior portion of the arch. In this case it appears that we are dealing with two aneurysms as shown in the lateral view. One is arising from the ascending portion and the other from the transverse arch. The displacement of the arch downward and backward is shown quite distinctly. Aneurysms may also arise from the concave or inferior aspect of the arch of the aorta. This is again best shown in the lateral view (Figs. 12 A and B). The anterior view shows a slight dilatation of the aorta on the left side beyond the arch. In the lateral view there is shown a bulging arising from the inferior surface of the arch which depresses the anterior wall of the trachea and the left bronchus. This partial obstruction resulted in a bronchiectasis. All the x-ray findings were confirmed by postmortem examination. An extreme case of marked dilatation of the aorta is illustrated in Figures 13 A and B. The lateral view shows that dilatation involves the whole of the thoracic aorta. The left bronchus is displaced downward and forward by the marked bulging of the concave surface of the arch.

Behind the trachea and parallel to it is the esophagus (Figs. 14 A and B) which cannot be recognized unless it is rendered visible by an opaque medium. The course of the esophagus from above downward is almost straight. Above, it is continuous with the cervical portion of the esophagus through the superior aperture of the thorax. Throughout its whole course it is in front of the spine with the exception of its lower extremity which deviates toward the left before it passes through the esophageal orifice in the diaphragm. In the region of the superior mediastinum it is in front of the bodies of the dorsal vertebrae. In the region of the posterior mediastinum the esophagus is behind the pericardium and in front of the descending aorta. It is never found to rest against the spine under normal conditions notwithstanding the

teachings of several anatomists to the contrary. The esophagus is crossed by the arch of the aorta on the left side. In



FIG. 23. Lateral view. Carcinoma of cardiac end of esophagus on posterior wall.

this region its contour is often found to be depressed by the arch of the aorta.

Under abnormal conditions the esophagus may be found to be displaced as shown in Figure 15, where the displacement is forward and is due to enlarged tracheal glands. Depression of the anterior wall of the esophagus as a result of cardiac enlargement is shown in Figure 16. Localized depression by enlargement of the left ventricle is shown in Figure 17. The esophagus is occasionally found to have a zigzag and distorted appearance when associated with a diaphragmatic hernia as shown in Figure 18. Perforation of the esophagus with extravasation of opaque medium into the mediastinal tissues is best illustrated in the lateral view (Fig. 19). This was primarily due to a carcinoma. Cicatricial strictures are also best shown



FIG. 24 A. Diaphragmatic hernia through esophageal orifice.



FIG. 24 B. Esophageal diverticulum of lower end of esophagus.



FIG. 25. Lateral view. Small diverticulum of cardiac end of esophagus.



FIG. 26. Anterior view. Cardiospasm. Fundus of stomach is normal.

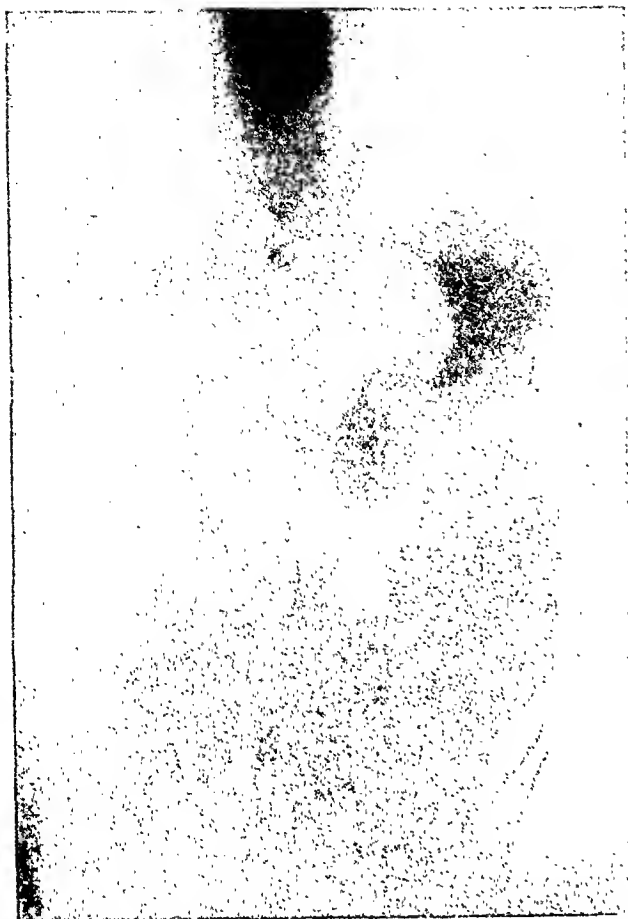


FIG. 27. Anterior view. Malignant tumor of stomach encroaching upon cardiac end of stomach, thus producing obstruction of esophagus. Appearance closely resembles simple spasm.



FIG. 28. Anterior view. Deviation of cardiac end of esophagus to left as result of malignant growth. Confirmed by operation.



FIG. 29 A. Anterior view. Displacement of descending aorta to left due to dilatation.



FIG. 29 B. Lateral view. Aorta is seen to overlap dorsal vertebrae.

in the lateral view. Figure 20 shows a stricture in the middle of the esophagus. Figure 21 shows a stricture at the cardiac

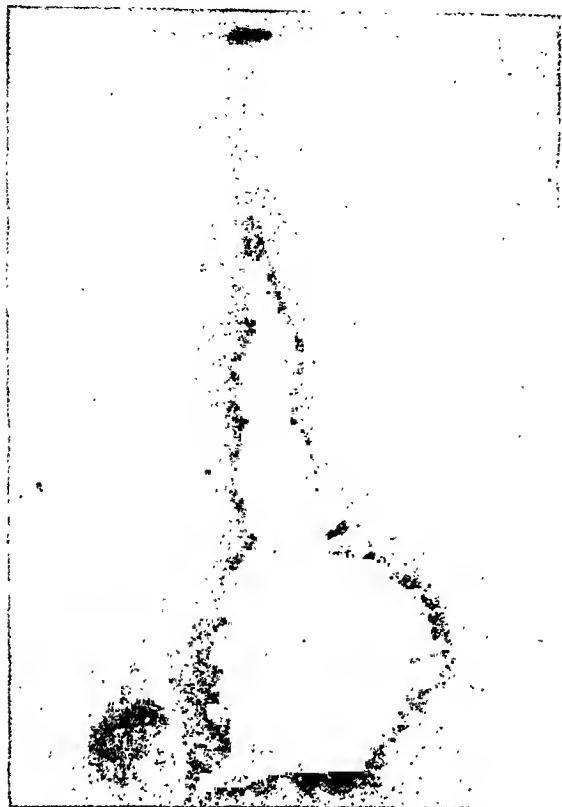


FIG. 30. Anterior view. Displacement of lower end of esophagus to left due to aneurysm of descending aorta.

end of the esophagus due to a caustic burn. Evidently the clear space between the opaque medium and cardiac end is due to ingested food which failed to pass the narrow opening of the stricture. Malignant strictures or deformities in the contour of the esophagus can also be demonstrated in the lateral view to their greatest advantage. Figure 22 shows deformity of the esophagus below its upper half. Figure 23 shows a deformity of the posterior wall of the esophagus at the cardiac end. Diverticuli of the lower end of the esophagus can readily be demonstrated in the antero-posterior or lateral views. The differentiation between a diverticulum of the lower end of the esophagus and a diaphragmatic hernia through the esophageal orifice is often difficult to make. A careful

study of the several characteristics associated with diverticula and diaphragmatic hernia has helped us in arriving to a correct diagnosis. Diaphragmatic hernia (Fig. 24 A) through the esophageal orifice presents the following differential points:

1. The part of the stomach above the diaphragm consists of the fundus and cardiac end of the stomach.
2. The expansion of the hernial sac is equally distributed on both sides of the spine.
3. The size of the hernia varies with the position of the patient. It is larger in the prone and smaller in the erect position.
4. The fundus is absent in the left hypochondriac region.
5. The stomach below the diaphragm is small.

Esophageal diverticulum of the lower end of the esophagus (Fig. 24 B) presents the following points:

1. The sac arises and communicates with the esophagus.
2. The sac is found to be located to one side of the spine.
3. The size of the sac remains the same in any position.
4. The fundus of the stomach is found in the region of the left hypochondrium.
5. The stomach is of normal size and shape.

Figure 25 shows a small diverticulum which was best shown in the lateral view. Cardiospasm of the esophagus should always include, if possible, an examination of the stomach in order to exclude a lesion of this organ. In the demonstrations of cardiospasm there is no special advantage in taking a lateral view. An anterior view (Fig. 26) will show the existing condition without any difficulty. Figure 27 to all appearances resembles a typical case of cardiospasm. However, a study of the stomach will show that the lumen is encroached upon by a mass which extends toward the cardiac end producing an organic obstruction. The position of the cardiac end of the stomach should always be watched. Any marked deviation from



FIG. 31 A. Anterior view. Dense shadow on left side of heart in case of Hodgkin's disease. Confirmed by biopsy.



FIG. 31 B. Lateral view. Anterior and posterior mediastinal glands are enlarged.



FIG. 32 A. Anterior view. Heart is displaced to left and superimposed upon heart shadow is another shadow presumed to be aorta.



FIG. 32 B. Lateral view. Region below arch of aorta is obscured by dense shadow. Diagnosis of tumor of posterior mediastinum was confirmed by postmortem examination.





FIG. 33 A. Lateral view. Ovoid transparent area is seen to be located between heart and aorta.



FIG. 33 B. Lateral view. After barium injection transparent shadow proved to be due to diaphragmatic hernia.



FIG. 34 A. Anterior view. Dense shadow on right side of heart.



FIG. 34 B. Lateral view. Spinal tuberculosis with abscess extending into posterior mediastinum.

the normal should lead one to suspect the possibility of an organic lesion (Fig. 28). The x-ray diagnosis of carcinoma of the

of the traches more or less prevents displacement to this side. Figure 29 A shows marked displacement of the descending



FIG. 35 A. Anterior view. Dense shadow on right side of heart.



FIG. 35 B. Lateral view. Tuberculous abscess originating from spine.

esophagus was confirmed by operation in this case.

The descending aorta is located in front of the spine. Under normal conditions but very little of it is seen in the anteroposterior view. Whenever the aorta is observed in the anteroposterior view it is either dilated or dislocated. In the lateral view its whole course can readily be seen in most individuals. Above, it is continuous with the arch of the aorta. Below, it is lost from view below the diaphragm. In its downward course it follows the dorsal spine very closely. A deviation in the course of the spine will reflect upon the course of the aorta. Whenever the aorta is found to overlap the bodies of the dorsal vertebrae in a true lateral view it is either displaced or dilated. Deviation of the aorta usually takes place to the left side, since this is the point of least resistance. On the right side the firm structure

aorta to the left. Figure 29 B shows the lateral view with the descending aorta overlapping the entire dorsal spine. An aneurysm arising from the descending aorta is best demonstrated with an opaque medium in the esophagus. The displacement of the lower end of the esophagus to the left in Figure 30 was due to an aneurysm.

Demonstration of enlarged glands or tumors in the posterior mediastinum is greatly assisted by lateral views. Figures 31 A and B show a case of Hodgkin's disease. Figures 32 A and B show a case of lymphosarcoma. Postmortem examination confirmed the x-ray findings. A rather unusual transparent shadow located between the posterior surface of the pericardium and the descending aorta (Figs. 33 A, B) proved to be due to a diaphragmatic hernia. It is needless to say that the anterior view failed to show anything abnormal. Occasionally abnormal shadows

in the neighborhood of the posterior mediastinum cannot be explained unless a study of the thorax is made in the lateral position. Figures 34 A and B and Figures 35 A and B show the exact nature of the shadows to be due to tuberculous spinal abscesses and that they are only encroaching upon the mediastinum, not originating from it.

#### CONCLUSIONS

1. A study of the superior and posterior mediastinum should include both an antero-posterior and lateral views.
2. The advantages of the lateral view over the anteroposterior view are shown by many illustrations.
3. The lateral view enables one to deter-

mine the position of the trachea in relation to the thoracic walls. Any deviation from its normal course and the probable cause can be determined with a high degree of accuracy.

4. The origin of aneurysms can be accurately determined by studying the location of the aneurysm in relation to the trachea.

5. Lesions affecting the esophagus can be studied with greater advantage in the lateral view.

6. Abnormal changes in the descending aorta are best recognized in the lateral view.

7. The exact origin of abnormal shadows encroaching upon the mediastina can be determined in the lateral view.



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\* Continued from p. 492.

ANESTHESIA FOR THE CARDIAC AND ASTHENIC PATIENT

PRELIMINARY REPORT OF THE ACTION OF SODIUM AMYTAL  
ON THE DISEASED HUMAN HEART\*

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PHILADELPHIA

**S**ODIUM amytal administered intra-venously or rectally in correct dosage reduces the tonicity of the voluntary muscles only slightly while the peripheral circulation is maintained, thereby reducing the possibility of shock to a minimum. Because of this lessened liability to shock the anesthetic is especially indicated for the weak and asthenic patient.

The following charts show the effect of sodium amytal on the cardiovascular system of 32 patients suffering with myocarditis. The degree of myocardial degeneration was determined by physical examinations and repeated electrocardiographic observations. The anesthetic was given forty-four times. The same number of observations were made in patients with normal cardiovascular systems for comparison.

CARDIOVASCULAR PATIENTS

No. of patients—31  
No. of anesthetics—44—Deaths 0  
Operations abnormal cardiovascular—Major 69 per cent—Minor 31 per cent  
Average age—61.4 years

Myocarditis	No. of Patients	Age	Age Dis-tribution
Mild.....	3	20-30	2
		30-40	1
Moderate.....	6	40-50	2
		50-60	8
Severe.....	15	60-70	12
		70-80	3
Serious.....	7	80-90	3

CARDIOVASCULAR CHANGES

	Myo-carditis	Normal Cardio-vascular
Average pulse pressure.....	71	44
Average systolic pressure.....	151	119
Average diastolic pressure.....	81	75
	Systolic Per Cent	Diastolic Per Cent
Average drop in blood pressure intravenous.....	40(26)	16(20)
Average drop in blood pressure rectal.....	27(12)	15(18.5)
Average drop in blood pressure intramuscular.....	12( 8)	4( 5)

	Systolic Per Cent	Diastolic Per Cent
Average drop in blood pressure intravenous.....	20(20)	8(6.6)
Average drop in blood pressure rectal.....	8(10)	4(3.3)
Average drop in blood pressure intramuscular.....		
Average drop in blood pressure supplement.....		
	Pulse Rate	Myocarditis
Drop.....	20 per cent	16 per cent
Rise.....	80 per cent	34 per cent
Rise—intravenous.....	16 beats	22
Rise—rectal.....	8 beats	

Cases of recent apoplexy showing ad-vanced arteriosclerosis, angina pectoris, auricular fibrillation and decompensation are included in this group. While the average pulse pressure in the myocardial group was 71 there were several patients in whom it was impossible to obtain a diastolic pressure, which would increase the actual average pulse pressure. While the comparative drop in systolic pressure in the two groups is slight (6 per cent) note that the drop in the diastolic pressure in the myocardial group is three times greater than that of the normal group; this is true for both the intravenous and rectal method of administration. As would be expected there are more than twice the number of patients showing an increase in pulse rate in the myocardial over that of the normal group. The surprising observation is that the intravenous administration did not increase the pulse rate in the myocardial over that of the normal group. In both normal and myocardial groups the rectal method of administration as advocated by Dr. Ravdin<sup>1</sup> produced the slightest circulatory change.

Sodium amytal supposedly produces narcosis by entering into solution with the fat-like constituents of lipid tissue.

<sup>1</sup> RAVDIN, I. S. *Am. J. M. Sc.*, 178: 379, 1929.

\* From the Department of Surgical Research, Temple University, and the Philadelphia General Hospital. Sub-mitted for publication June 23, 1930.

The action of the drug on the human brain is similar to its action on the brain of the dog, except that the human brain

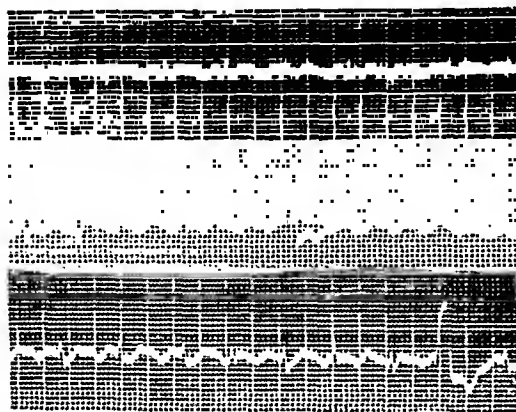


FIG. 1. Auricular flutter with frequent ventricular extra systoles. In addition, ventricular waves are of low amplitude.

is a little more susceptible, requiring less to produce profound sleep. This may be due to the fact that our psychic centers are more highly developed. Sodium amytal abolishes will and intelligence but it does not completely isolate the patient from his surroundings. He is still capable of

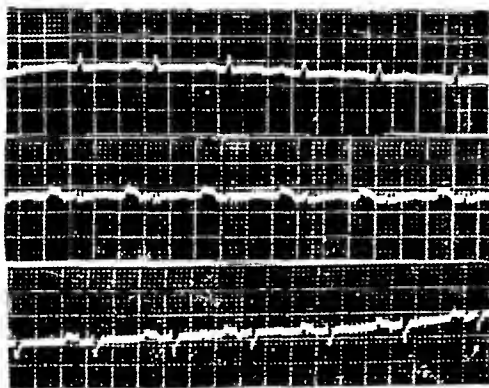


FIG. 2. Tracing shows normal sinus mechanism. P. Waves notched and big and probably can be taken as evidence of disease of auricular muscle. Otherwise, change in mechanism reveals no new evidence. Ventricular waves all of low amplitude.

responding to external stimuli, is restless and is apparently conscious, answers questions at times but *he does not remember*. The pupils are slightly contracted, the gag and skin reflexes are usually maintained, the patellar reflexes are lost. The lips are slightly cyanosed and by contrast increase the associated pallor of the skin.

The effect of the drug on the respiratory

system varies with the method of administration. If given intravenously at the rate of 1 c.c. per minute, the patient

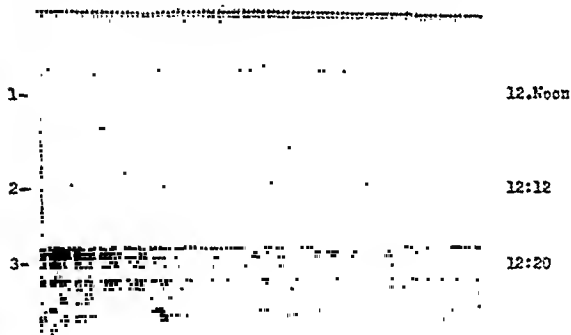


FIG. 3. 1, Injection of sciatic nerve. 2, Division of sciatic nerve. 3, After division of sciatic nerve.

almost invariably yawns at the end of three and one-half to four minutes. Within a moment or two he falls into a peaceful sleep and will continue to sleep unless disturbed. If given rectally, yawning occurs usually at the end of fifteen minutes and he is sound asleep in from thirty to forty minutes. Apparently this preliminary yawn is significant of changes in the

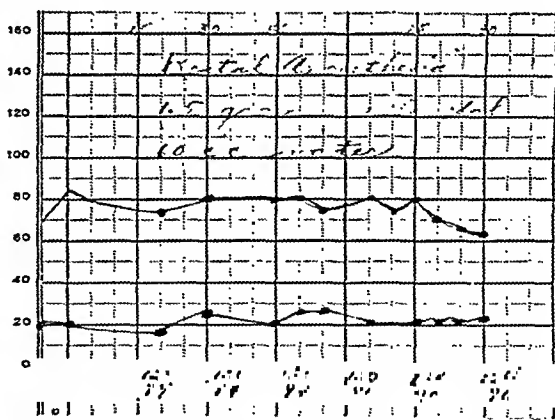


FIG. 4. Rectal anesthesia. 1.5 gm. amytal. 60 c.c. water.

cranial cavity similar to that which takes place directly before and during sleep. We reviewed the literature but were unable to find an explanation of the cause of the yawn. We found that the cerebrospinal pressure is reduced at times as much as 50 per cent, frequently 20 to 30 per cent, precisely at the time the patient yawns. We have kept the needle in the spinal canal as long as fifteen minutes; during this time there was

approximately a 20 per cent rise above the maximum of 50 per cent drop. This is at variance with the findings of Stevenson<sup>1</sup> and his co-workers who studied the intracranial pressure in individuals with hernia cerebri during normal sleep and found an increase in intracranial pressure. The pressure gradually rose until the patient was sound asleep when the curve reached its maximum; this was maintained at a fairly constant level.

We believe the yawn is clinical evidence that the rate of injection of the drug is correct as we have observed that when given too rapidly the patient goes to sleep without it. Untoward symptoms are likely to develop under such circumstances as shown by the following: Our first injection was in an arteriosclerotic male aged sixty-four, in whom a diagnosis of carcinoma of the stomach was made. We were scrubbing when I turned to the resident physician and said, "Will you give the patient the sodium amytal?" He left me and returned in a few minutes and said, "That's the funniest experience I ever had, that man went to sleep in exactly thirty seconds, I timed him." On examination we found that his respirations were disturbed and we deferred the operation. He slept for about eighteen hours. We operated a few days later using a smaller dose of sodium amytal, combined with novocaine. We were unable to obtain a diastolic pressure in this patient at any time.

While the preceding illustrates the effect of the drug on the respiratory center and its safety even in advanced arteriosclerotic disease with myocardial degeneration the following case shows its value in the pathology of the intrinsic cardiac nervous mechanism and in coronary disease associated with advanced myocarditis.

A. male, aged sixty-four was admitted to the Philadelphia General Hospital with symptoms of acute cardiac distress, dyspnea, cyanosis, marked distention of the superficial veins, puffiness of the face, cough and pretibial edema. Examination showed diffuse pulsations over the precordium and epigastrium but no definite rhythm. The pulse was irregular and

rapid, the systolic blood pressure 110; diastolic could not be obtained. A diagnosis of auricular fibrillation with myocardial degeneration was made. This was confirmed by the electrocardiograph (Fig. 1). The patient was digitalized and rhythm became normal (Fig. 2). Fourteen days after admission he developed gangrene of the right leg, lower third; twenty-one days after admission an amputation was done at the lower third of the thigh, sodium amytal being used, rectal administration and procaine, local infiltration. The electrocardiograph was connected to the patient during the operation. The accompanying charts show the electrocardiographic tracings (Fig. 3), changes in pulse, blood pressure, and respiration throughout the operation (Fig. 4). He made an uneventful operative recovery.

In another male aged fifty-six who had a primary carcinoma of the lung associated with myocarditis and angina pectoris, sodium amytal was administered four times with no ill effects; directly prior to the second operation he developed an attack of angina which was not relieved by a hypodermic of  $\frac{1}{2}$  grain of morphine sulphate but was relieved by an intravenous injection of 3 c.c. of a 10 per cent solution of sodium amytal; he fell asleep at the end of three minutes and slept for eighteen hours.

While only 22.5 per cent of this series of cardiac patients were as seriously affected as the three previously mentioned, our observations of the effect of sodium amytal on these and the others less seriously affected, warrants our advocating its use in such cases alone or in combination with local or block anesthesia.

#### CONCLUSIONS

1. Sodium amytal has little direct effect on the diseased heart muscle.
2. The slight circulatory changes associated with the administration of the drug are due to (1) and to the maintenance of tone in the voluntary muscles and the peripheral circulation.
3. The initial effect of the drug on the central nervous system is associated with a change in cerebrospinal pressure.
4. Because of the drop in cerebrospinal pressure sodium amytal should not be given as a preliminary to spinal anesthesia unless allowance is made for the increase in diffusibility.

<sup>1</sup> STEVENSON, L. *Am. J. M. Sc.*, 178: 663, 1929.

# SURGICAL TREATMENT OF CHRONIC EMPYEMA\*

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ANYONE who makes a critical study of the subject of empyema, acute or chronic, will be faced with the limited understanding or experience which is expressed by statements concerning the proper infrequency of chronic empyema or the good prognosis which should accompany the treatment of chronic empyema. Neither of these statements is correct. The frequency of chronic empyema will vary from year to year under the influence of business conditions affecting general health and hygiene; will vary according to the type of bacterial infection which is causative of the primary lesion, the streptococcus and mixed infection producing the largest number of chronic cases; finally, the type of complications which are encountered in the pathologic picture.

It is an absolute essential that the nature of acute empyema be understood. Since the chronic form of empyema will not occur until an acute case has had its run, many acute empyemata will become chronic under the misunderstanding of its serious nature. It is this fact which has led to most of the statements that there should be no chronic empyema. If one pursues a faulty course in the acute disease, the chronic suppuration will inevitably occur.

Acute empyema is a grave disease. It is not sufficiently realized that mixtures of infections will lead to chronicity. Other factors favoring chronicity are those which allow any cavity to remain in the pleura, between the lung and the chest wall. Inserting a tube, even a small one, will permit a tiny pocket to form around this tube, which will not empty, even after the tube is withdrawn. Localization of pus in places awkward to insert drainage will lead to long-standing suppuration. Such places are between the lobes of the lung

and between the lung and the mediastinum; more rarely between the lung and diaphragm. Rupture of the lung, with bronchopleural fistula, allows an artificial pneumothorax, mixture of infection, and inability to expand the lung, or collapses the chest wall without considerable and extensive surgical procedures. Finally, the most severe of all forms of chronic empyema will be produced by lung abscess which may or may not have ruptured through into the pleura.

The formation of a pocket of pus of long standing will eventually lead to thickening of the pocket, and cicatrization of the fistulous tract leading from the bronchi to the pleura. To hope to remove this scarring, even with the softening influence of Dakin's solution, is almost impossible. Especially is this the case in the presence of a fistulous tract, where Dakin's solution gains entrance into the trachea and pharynx. The irritating action of the chlorine stimulates coughing, with spasmodic respiration, and leads to greater filling of the pocket with air and extension of infection. To expect to cure all cases of acute empyema without encountering some of these complications which lead to chronic empyema is expecting the miraculous. It follows therefore that in a certain percentage of cases of acute empyema, chronicity will result. In like manner, when one deals with the severe forms of complicated lung suppuration which associate themselves with or cause chronic empyema, the prognosis is indeed grave.

The error of the former open method of treating infections of the pleural cavity lay in the mixing of infections early in its course. Such a mistake will constitute positive assurance of chronic empyema. Many cases of acute empyema will be healed by aspiration through a fair sized

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needle, repeating the drainage at intervals of several days depending upon the amount of suppuration. The existence of pleural exudation should be recognized early, but approached with greater leisure. Milder bacterial forms of infection may be dealt with earlier; the more virulent orders should be permitted longer time to collect before removal of the fluid. At approximately the interval of change from clear fluid into cloudy is the optimum time for initial drainage. From this time on the reduction of bacterial content of the suppuration fluid is indicative of improvement as is also the decreasing temperature of the patient.

Where these factors are not present, some complicating element in the progress of the patient is indicated and search must be made diligently until a correct analysis of the situation is completed.

Under ordinary circumstances, where no communication exists from the pleura to the respiratory tract, the use of Dakin's solution will dissolve out all fibrous tissue and allow expansion of the lung, at the same time assuring adhesions of the lung to the chest wall as the expansion takes place. No more of the fluid than the cavity will hold should be injected at any one time, or the adhesions already formed will be broken down again. Formation of adhesions irregularly, leaving small pockets of pus bedded around with adhesions, does not leave the patient well. The illness will continue, sometimes penetrating into the lung tissue or breaking down the pockets existing into one large pus sac. With the chlorine solution as an antiseptic, the tiny pocket made by a tube in the pleura is not usually formative of residual suppurative material. With other forms of antiseptics, however, a small pus pocket may remain. Mansur has recently reported a splendid simple constant vacuum aspiration tube, the Wilson tube, which may be placed through the chest wall in acute empyema. It has a flat disc surface on the interior and exterior of the chest wall with a flap over

its outer opening. Its insertion cannot leave any space within the pleural cavity which is not filled by lung tissue. It does not leave the protruding tip of a tube to prod the lung, form a small pocket, or penetrate into the respiratory passages. This is the simplest and safest device as yet produced for the purpose of drainage of the empyema cavity.

This cannot be used however on patients with interlobar collections of pus, or between the lung and mediastinum, or even at the diaphragm. In the common customary pus pocket collecting between the chest wall and the lung, the optimum point of drainage is in the sixth intercostal space in the posterior axillary line, since with the patient resting in bed, this is the dependent point of the barrel-shaped thorax. In the cases of interlobar suppuration, a tube may be passed into the pus cavity, which will gradually be withdrawn as the infection subsides. This type of pathology is most likely to form bronchopleural fistulas, so great care is needed in the handling. Roughness on inserting the tube may puncture the friable infected lung tissue. This is true at the periphery of the lung as well as at the more central portion of the fissures. It is the penetration of lung which may lead to abscess formation also, though more commonly the etiology of abscess in the lung is pneumonia. The filling of the lung with pneumonic change decreases the blood supply. Sufficient filling of the alveoli with necrotic material will completely shut off the blood vessels, which under pressure and in the presence of septic material allows decay and necrosis of the alveolar walls. When the pneumonia passes off, the breaking down of the necrotic tissue leaves an abscess pocket. This, in the presence of empyema will frequently produce a vicious circle, each lesion stimulating the persistence of the other and preventing its proper response to treatment.

The treatment of uncomplicated chronic empyema is the same as the acute; empty-



ing and sterilizing the cavity, and allowing complete collapse of the sac by expansion of the lung substance. This can be accomplished fairly readily where there is no communication between the pleura and respiratory passages, or abscess formation. Careful x-ray work with roentgen plates and fluoroscopic study will inform the surgeon of the exact condition present. The treatment depends entirely upon a clear-cut comprehension of the pathology. The outlook to the patient is extremely grave at best, and only a most painstaking analysis of the problem will give the satisfaction of good health to both the patient and the attendants.

In cases of bronchopleural fistula or lung abscess healing cannot occur without some form of surgical interference, usually of extensive nature. The best operation for bronchopleural fistula is the paravertebral thoracoplasty, the extensiveness of the dissection depending upon the size of the suppurating cavity. The aim or purpose of the operation is to collapse the chest wall against the lung, thus closing the exudative pocket. The pressure of the chest wall usually closes the fistulous tract and relieves the pleura of air entry. The former custom of removing the bony structure from immediately over the suppuration is not dependable because the chest will not collapse from the curvature of the ribs to the vertebral column. The rib structures attached to the laminae will become elevated instead of falling. The chest tends to flatten anteroposteriorly, but the added advantage of lateral collapse is lacking. Both the anteroposterior and lateral depression are obtained by the paravertebral thoraco-

plasty, so this is the operation of choice. In some instances, the removal of the intercostal muscles and the ribs, as devised by Schede of Hamburg, may be the selected operation, though this carries with it a higher mortality than any other. It is more likely to be chosen in case of abscess of the lung in combination with empyema.

Some lung abscesses respond to milder forms of treatment as postural, or pneumothorax together with bronchoscopic drainage. The presence of fluid in the pleura accomplishes the pneumothorax, and if, as so often happens, bronchopleural fistula is also established, there is present a source of suppuration which, as shown, calls for more elaborate and more dangerous forms of surgical attack. Lilienthal has had splendid success in making a collapse of the chest wall and sinking the integumental flap into the widely opened abscess of the lung, allowing free granulation to help close the cavity. The removal of a portion of the lung for abscess in the presence of empyema is ill advised as a primary procedure, as lobectomy at best carries such great risk. Some less radical operation is best tried first.

Chronic empyema is a necessary evil, not easy to overcome when accompanied by such variants as peculiar placement of pus pockets, bronchopleural fistula, or lung abscess. Uncomplicated chronic empyema will readily respond to drainage, sterilizing and collapse of the cavity. Complicated empyemata are not to be considered in the same category and will require elaborate, dangerous methods of surgical approach, the selection of which will be determined only by careful study of the pathology present and the needs of the patient.



# THE DANGER OF THE PROLONGED USE OF LUGOL'S SOLUTION

IN THE TREATMENT OF EXOPHTHALMIC GOITER WITH CASE REPORTS  
AND A STUDY OF THE PATHOLOGY\*

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A NUMBER of very critical conditions and deaths have recently resulted from the misuse of iodine in the treatment of exophthalmic goiter. Although several physicians have called attention to this danger, we have not noted a report of any series of cases showing the harmful effects of the promiscuous use of iodine therapy. We have observed occasional "iodine fast" cases of exophthalmic goiter for several years, but the number has increased so markedly during the past year that the seriousness of this evil is apparent. We believe it is time for those who are administering iodine so freely to these patients, to know the facts and the end-results of this type of treatment.

In 1924 one of us (A. S. J.) called attention to the danger of giving iodine promiscuously to persons with adenomatous goiter and suggested the term "iodine hyperthyroidism" for this syndrome. In a short time more than 50 cases, including 3 patients who died, were examined. We feel that this warning with regard to the misdirected form of therapy may have accounted for the steady decrease in the number of cases which are now seen.

Only a few years ago physicians gave iodine freely without regard for the kind of goiter, unless it was of the exophthalmic type. All medical schools and textbooks warned against using iodine for this condition. Perhaps some of this apprehension was due to Kocher, who called attention in 1895 to the danger of iodine in the treatment of goiter and suggested the term Jod Basedow's disease for the toxic condition which resulted from its use. This condition, however, is not Basedow's disease or exophthalmic goiter, as it is commonly

known, but iodine hyperthyroidism, a toxic condition produced in a previously non-toxic adenomatous goiter by the use of iodine. As a result of the wide dissemination of Kocher's theories a great fear of using iodine developed, particularly of using it in Basedow's disease.

In 1912 Marine showed that iodine caused a marked reversion of the hyperplastic to the colloid state in exophthalmic goiter; but it was not until 1923 that Plummer proved beyond a doubt that a remarkable clinical improvement resulted from the use of iodine in this disease.

Too often in medical literature supposed facts are handed down from generation to generation without the author's even attempting to verify the conclusions or to ascertain the source from which they were drawn. Another example of the fallacy of these hackneyed ideas is that concerning the use of meats, particularly red meats in this disease. No one has ever proved meat to be harmful in Basedow's disease any more than in hypertension. Yet, in the standard textbook on goiter between the period 1900 to 1922, one finds, "when the disease has got a firm hold on the patient, if he continues to eat freely of red meats such as beef, veal, mutton, or pork, nothing becomes plainer than the futility of drugs and especially those directed against mere symptoms."

We now know that such statements are inaccurate and yet they are still being quoted and taught. When Plummer showed that iodine had a remarkably beneficial effect on patients with exophthalmic goiter his conclusions were received with considerable doubt, because the adverse opinion had been accepted for so many years. Gradually, however, reports of series of

\* Submitted for publication August 14, 1930.

cases from various parts of the country appeared to verify his statement. He early called attention to the fact that Lugol's

the remarkable effect was observed and patients were saved in a spectacular manner from crises and restored to a

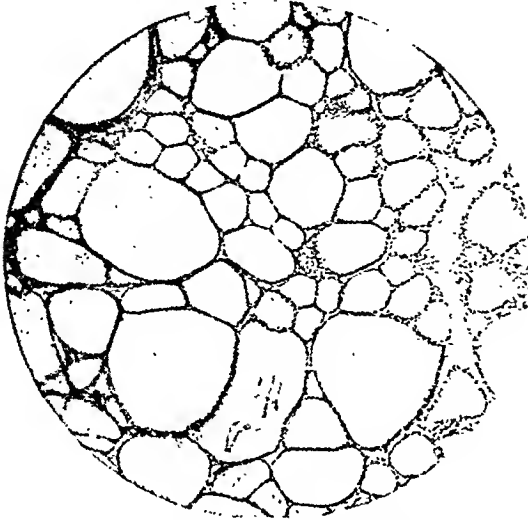


FIG. 1. (Case 57.) Exophthalmic goiter. Patient had been on iodine continuously for more than two years and had taken one dram of Lugol's solution daily for one year prior to operation. ( $\times 12$ .)



FIG. 2. Same as Fig. 1. ( $\times 62$ .)

solution did not effect a cure, but was of great benefit when used in preparing the

state of well-being in a few weeks' time, physicians threw caution aside and gave iodine freely.

After taking iodine, the bedridden pa-

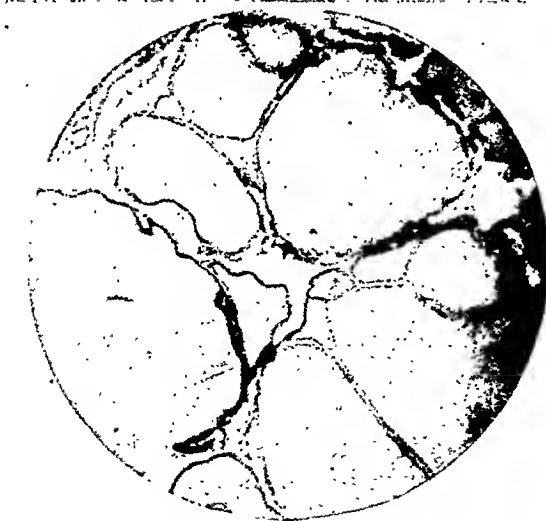


FIG. 3. (Case 52.) Iodine continuously for more than two years. ( $\times 12$ .)

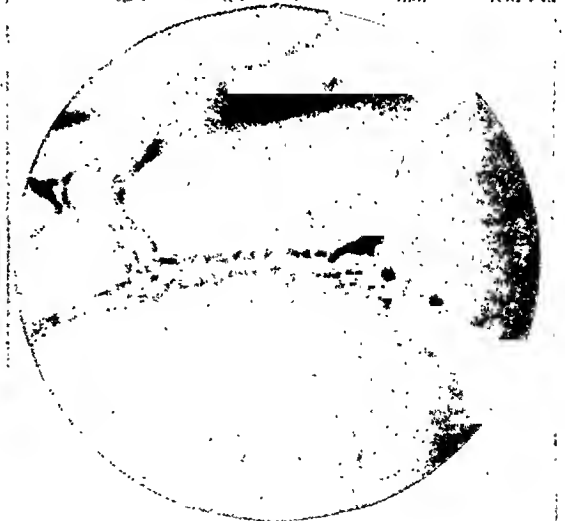


FIG. 4. Same as Fig. 3. ( $\times 62$ .)

patient for operation, or in bringing a patient through a crisis.

At first Lugol's solution was administered cautiously in small amounts, and for only short periods of time. Later, when

tient was not only able to be up and about in a few days, but he gradually gained weight, the heart and tremor quieted down, his strength as well as his normal disposition returned, the stare disappeared, and he seemed benefitted in every way.

This improvement continued for weeks and even months. The metabolic rate frequently returned to normal, or at least

benefit in exophthalmic goiter, this was followed by a period in which the patient became "iodine fast" and developed a

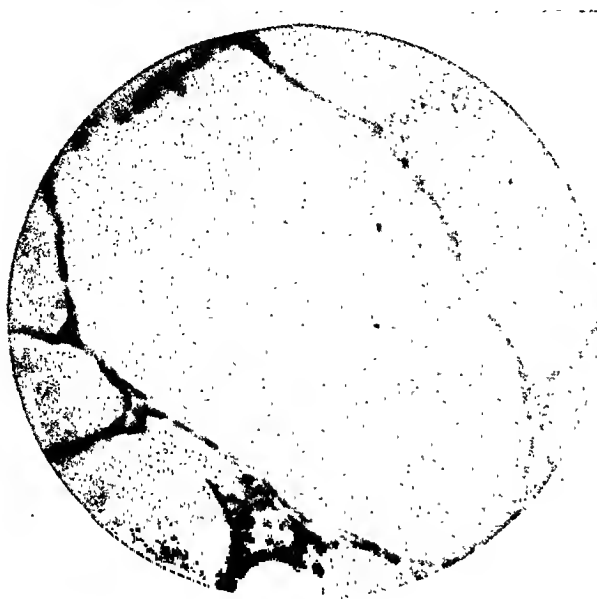


FIG. 5. (Case 53.) Iodine for six months. ( $\times 62$ .)

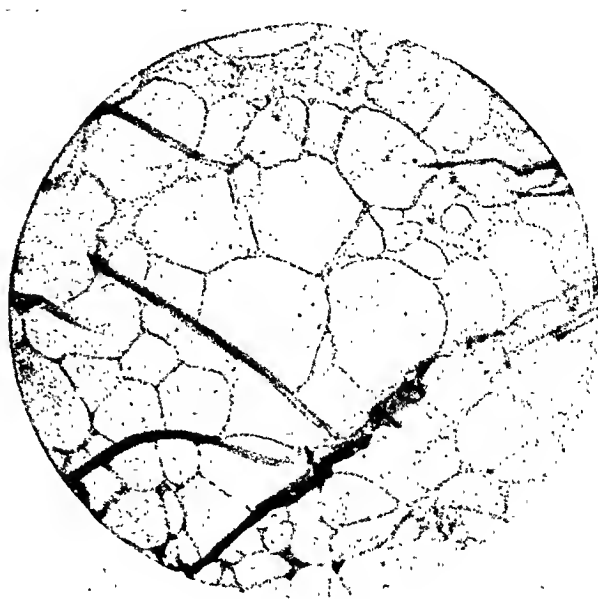


FIG. 6. Same as Fig. 5. ( $\times 12$ .)

dropped considerably. The patient was often able to resume his duties. In the meantime a note of warning was sounded

tolerance to the drug. The metabolic rate again became elevated and the myocardium was so damaged that auricular



FIG. 7. (Case 54.) Iodine for six months. ( $\times 62$ .)

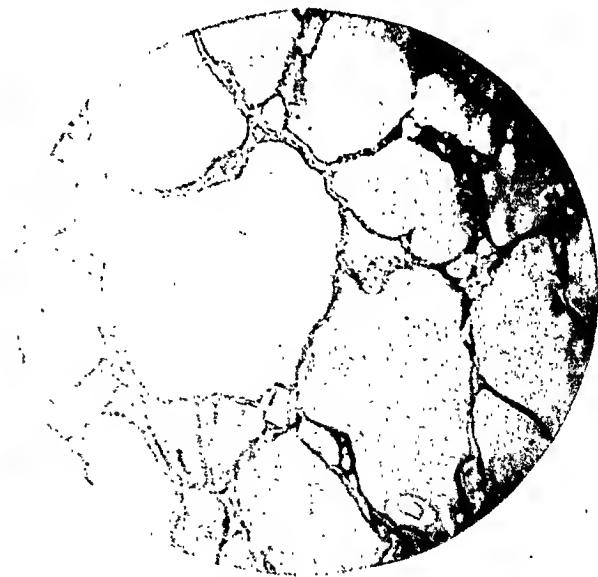


FIG. 8. Same as Fig. 7. ( $\times 12$ .)

by those who were seeing their first "iodine fast" cases.

At the meeting of the American Society for the Study of Goiter in 1928, one of us (A. S. J.) called attention to the fact that although iodine effected a temporary

fibrillation often occurred. In the meantime the patient had improved, to all outward appearances, and had often gained 30 or 40 pounds.

The period of improvement is variable. Some patients respond very well for three

or four weeks, and then, in spite of rest and continued large amounts of iodine, it is impossible to bring them back to their

The unfortunate outcome of two such operations in patients who were in this condition, having received Lugol's solution



FIG. 9. (Case 55.) Iodine for two months. ( $\times 62$ .)

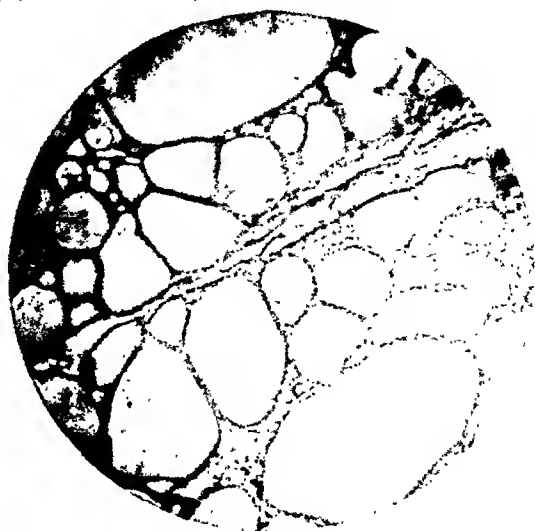


FIG. 10. Same as Fig. 9. ( $\times 12$ .)

former state of health. Eventually these patients seek the surgeon's help, and he must face a grave responsibility. The risk of operation is frequently as great

for several months before coming to us, has proved to our satisfaction that lobectomy or even ligation is the operation of choice. However, I have not found it



FIG. 11. (Case 56.) Iodine for seven months. ( $\times 62$ .)

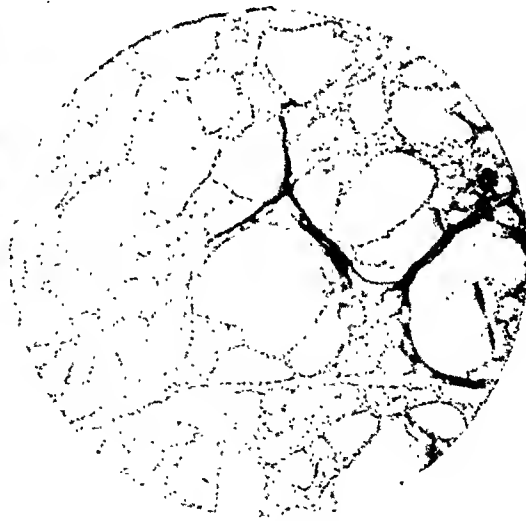


FIG. 12. Same as Fig. 11. ( $\times 12$ .)

as in the days before Lugol's solution was used. For years primary thyroidectomies have been done in all cases of exophthalmic goiter at our Clinic, but we feel that this procedure is not a safe one for the patient who has become "iodine fast."

necessary to delay the second stage of the operation more than a week or ten days, because in most instances the metabolic rate has dropped to 25 or lower which, in the absence of any other complications, is a safe rate at which to complete the operation in this kind of goiter.

## PATHOLOGY

The structural changes occurring in the thyroid gland after the administration of

tion in hyperplasia and hypertrophy is present. Papillary infoldings are flattened or ironed out. Vessels and lymphatics in



FIG. 13. (Case 54.) Same as Figs. 7 and 8. This patient had taken iodine for six months. Postoperative reaction was very severe and his life probably was saved by use of oxygen tent.



FIG. 14. (Case 57.) Same as Figs. 1 and 2. Case of exophthalmic goiter, probably longest on record, as patient had been on iodine continuously for more than two years.

iodine have been studied and described by many authors. The essential changes induced consist in an accumulation of colloid, temporary diminution of activity, a decrease in the vascularity, and a reduction in the degree of hyperplasia and hypertrophy. Grossly the gland becomes larger and more firm than the untreated ones. There is visible colloid.

Microscopically intra-acinar colloid is markedly increased and even staining. There is not much tendency to vacuolization. The colloid completely fills the acini and abuts the epithelium. The acini are more uniform in size, and a marked reduc-

tion in the stroma are compressed. The lining epithelium of the acini varies somewhat in size and shape, but a low cuboidal or flattened cell is found in most instances. In areas where the gland has resisted the action of iodine the cells tend more to a columnar type. The cytoplasm of the cell is more finely granular. The nuclei are smaller and stand out prominently.

The mechanism of the beneficial effect produced by iodine is a question which is much debated. Several theories have been advanced, none of which adequately answers all questions. Marie believes that there exists at the time a disproportion

between iodine content and the requirement of the organism, rather than a deficiency of iodine.

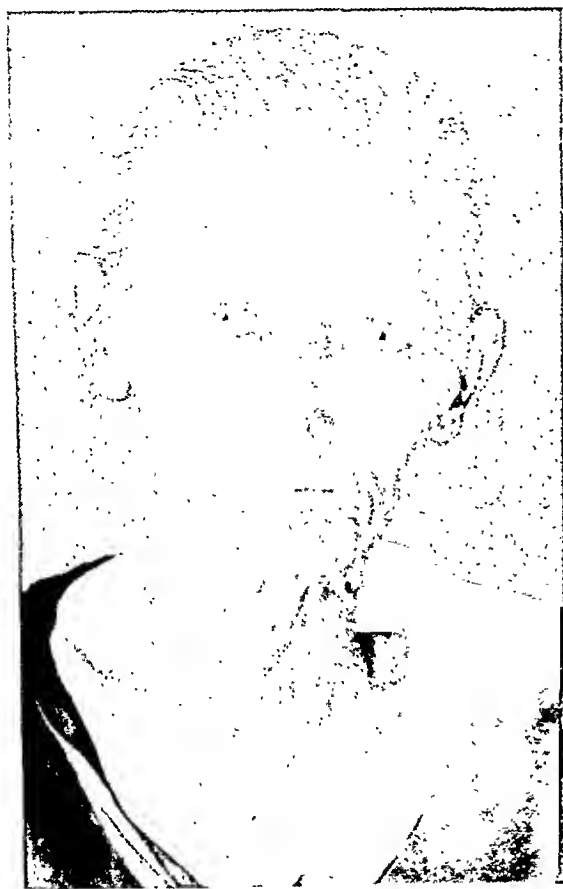


FIG. 15. (Case 50.) Advanced case of exophthalmic goiter. Patient had been on iodine for three months. In spite of careful preparation patient was unable to survive a lobectomy.

Marine explains the effect as being due to a holding back of secretion from the storage of colloid. Plummer writes: "Many reactions which might follow the administration of iodine were considered. The complete iodination of the thyroxin molecule in the tissues of the body seemed possible but not probable. That the iodine might lead to more complete iodination of thyroxin in the gland or that it might block its discharge seemed more probable." Plummer also states that irrespective of the degree of stimulation the thyroid will not elaborate much of the abnormal secretion if a sufficient amount of the iodine is available.

As previously mentioned, no one theory will satisfactorily explain the clinical variations found following the administration of iodine to patients with exophthalmic goiter, the short remission of symptoms with improvement in the patient's general condition followed by a return of symptoms, and in most instances with increased severity. There exists no definite relation between the histologic picture and the clinical symptoms.

The photomicrographs are of thyroids removed from patients who had been taking iodine for periods varying from eight weeks to two years; one patient took one teaspoonful of Lugol's solution daily for one year (Fig. 1). We shall not describe the microscopic picture in each individual slide. Areas which were representative of the entire section were photographed. The findings in general correspond with those mentioned previously in this paper. The variations present are chiefly in the amounts of hyperplasia and hypertrophy and in the breaking through the colloid of these areas. Clinically all cases were classified as poor surgical risks. We do not find evidence of exhaustion of the gland as mentioned by Frazier and Mosser.

The clinical and pathological observations on these cases would indicate that the mechanism of the action of iodine is in all probability a combination of factors. Mechanical compression of the cell with temporary inhibition of activity of nearly all areas has some pathological basis for support.

The following table is a brief résumé of the cases of exophthalmic goiter of the "iodine fast" type. These patients were operated on during the past four years. In this same period primary thyroidectomy was performed on other patients with exophthalmic goiter with a mortality rate of one-half of 1 per cent.

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[For additional bibliography see p. 520.]

No.	Sex	Age	Duration of Symptoms	Duration of Time on Iodine	Result of Iodine Treatment	Weight Loss (Lb.)	Blood Pressure	Basal Metabolism Rate			Pulse		Sequelae	Result B. M. R.
								Pre-Lugol's	Post-Lugol's	Rate	Pre-Lugol's	Post-Lugol's		
1	F.	42	2 years	6 months	Temporary improvement	40	150/64	+53	+48		98	87	Myocarditis	+14
2	F.	33	6 months	1 month	Temporary improvement	12	148/76	+75	+59		132	104		+4
3	F.	23	1 year	4 months	Improved for 2 months	13	118/76	+42	+43		105	106	Marked dilatation of heart	+9
4	F.	32	10 months	5 weeks	Temporary improvement	10	146/66	+61	+55		116	111		+11
5	F.	16	10 months	10 months	Improved for 9 months	15	140/76	+44	+47		144	130		0
6	F.	47	7 months	6 months	Improved heart slower	0	160/90	+44	..		155	130	Auricular fibrillation	+26
7	F.	52	6 months	6 weeks	Temporary improvement	12	160/80	+49	+41		104	92	Hypertension; myocarditis	0
8	F.	39	3 months	3 months	Temporary improvement	10	145/80	+47	+83		88	86	Hypertension; myocarditis	+10
9	F.	33	1 year	1 year	Gained 15 lb.	25	98/40	+73	+83		117	108	Hypertension; myocarditis	Died
10	F.	15	1 year	6 months	Temporary improvement	15	140/65	+65	+37		120	110	Hypertension; myocarditis	+8
11	F.	39	6 months	3 months	Temporary improvement	25	140/55	+47	+28		128	100		+19
12	F.	24	7 months	6 months	Temporary improvement	10	130/75	+47	+40		101	90		+2
13	F.	26	5 months	5 months	Leys tremor	7	140/30	+56	+40		102	..	Hypertension	..
14	M.	49	3 months	2 months	Gained weight	36	163/78	+55	+58		..	..		..
15	F.	28	3 months	2 months	Temporary improvement	31	169/68	+93	+44		115	93	Heart enlargement	+11
16	F.	36	4 months	1 month	Appetite better	32	140/80	+51	+44		110	106	Myocarditis; hypertension	+11
17	F.	41	4 months	2 months	Temporary improvement	5	208/70	+62	+33		120	102	Myocarditis; hypertension	..
18	F.	38	1 year	1 year	Temporary improvement	0	250/10	+95	+43		128	119		..
19	F.	55	4 months	4 months	Temporary improvement	40	210/120	+55	+28		122	90		..
20	F.	36	6 months	3 months	Temporary improvement	15	140/72	+48	..		90	..		..
21	F.	36	5 months	6 months	Temporary improvement	17	118/72	+38	+32		100	90		..
22	F.	48	4 months	3 months	Temporary improvement	17	148/64	+71	+50		106	97	Hypertension	+3
23	F.	20	7 months	7 months	Temporary improvement	28	268/80	+60	+26		145	131	Myocarditis; hypertension	+10
24	F.	50	1 year	3 months	Gained 3 lb.	8	140/80	+49	+61		120	102	Myocarditis; hypertension	+10
25	F.	14	3 months	3 months	No improvement	30	210/80	+66	+30		170	140	Auricular fibrillation	+13
26	F.	69	1 year	2 months	Improvement	10	120/80	+65	+26		115	98	Chronic myocarditis	+23
27	M.	40	2 years	9 months	Temporary improvement	12	158/78	+36	+30		131	116	Hypertension	+1
28	F.	20	2 years	2 months	Temporary improvement	10	150/84	+75	+67		112	..		..
29	F.	34	6 months	2 months	Improved	4	145/78	+60	..		108	..	Myocarditis, chronic	9
30	F.	66	1 year	9 months	Improved	24	130/70	+48	..		105	..		..
31	F.	42	2 months	6 weeks	Slight improvement	10	140/75	+59	+37		114	105	Myocarditis, chronic	2
32	F.	31	5 months	3 months	Gained 25 lb.	45	140/74	+55	+63		122	111		5
33	F.	43	3 weeks	1 week	Slight improvement	17	132/60	+35	+36		83	79		..
34	M.	42	5 months	1 month	Temporary improvement	4	140/84	+29	+23		118	114		..
35	F.	42	3 months	6 weeks	Temporary improvement	18	140/70	+36	..		75	..		..
36	M.	45	3 1/2 months	1 month	Temporary improvement	35	170/80	+42	+30		105	108		0
37	F.	40	1 year	1 month	Slight improvement	39	170/80	+42	+30		110	85		+12
38	M.	69	4 months	2 months	Temporary improvement	12	148/76	+75	+50		132	104		Died
39	F.	31	6 months	1 month	Temporary improvement	40	150/64	+53	+48		98	87	Myocarditis, chronic	+4
40	F.	42	6 years	9 months	Gained 20 lb.	52	210/75	+81	+57		120	105	Myocarditis & auricular fibrillation	Lid
41	F.	66	6 months	6 months	Temporary improvement	40	160/70	+70	+84		148	127	Auricular fibrillation	+16
42	F.	48	1 year	9 months	Temporary improvement	10	200/20	+62	+58		90	85		+16
43	F.	45	2 1/2 years	4 months	Temporary improvement	20	170/60	+50	..		100	..		+16
44	F.	25	1 year	3 months	Temporary improvement	30	180/90	+52	+66		148	130		+16
45	F.	50	1 year	1 year	Temporary improvement	24	150/90	+50	+36		113	97		+2
46	F.	48	4 months	3 weeks	Temporary improvement	24	138/62	+35	+34		108	100	Chronic myocarditis & hepatitis	+12
47	F.	35	2 years	3 months	Temporary improvement	10	130/68	+32	..		78	..		..
48	F.	33	10 months	4 months	Temporary improvement	40	140/78	+25	..		96	..		2
49	M.	54	2 years	3 months	Temporary improvement	15	140/78	+25	+37		125	114	Hypertension, myocarditis, auricular fibrillation	Died
50	F.	54	4 months	3 months	Temporary improvement	45	160/80	+43	..		..	..		..
51	M.	48	5 months	3 months	Temporary improvement	50	125/60	+49	+33		115	85		+4
52	M.	42	4 years	2 years	Temporary improvement	34	155/65	+50	+60		110	95		+10
53	M.	52	6 months	6 months	Temporary improvement	20	160/88	+42	+31		85	84		+3
54	M.	43	8 months	6 months	Temporary improvement	30	150/78	+37	+31		100	100		+12
55	M.	47	4 months	2 months	Temporary improvement	50	180/86	+60	+30		110	90		+4
56	F.	38	1 year	7 months	Temporary improvement	11	150/78	+57	+30		115	87	Chronic myocarditis, cardiac dilatation	+5
57	F.	24	2 1/2 years	2 years	Temporary improvement	10	150/90	+77	+51		143	139		2



# SURGICAL GOITER

HOW MODERN METHODS OF PREPARATION, ANESTHESIA AND TECHNIC HAVE  
IMPROVED THE SURGICAL RESULTS AND REDUCED MORTALITY  
TO AN ALMOST NEGLIGIBLE PERCENTAGE\*

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**B**EFORE discussing the purely surgical phases of exophthalmic and toxic adenomatous goiter, it may be well to mention briefly a few of the embryologic and anatomic facts that have a bearing on surgical pathology.

The thyroid pouch, the precursor of the thyroid gland, is the first parenchymatous organ to appear in the human embryo. As the epithelial cells of the pouch multiply, a mass is formed, which gradually descends through the developing muscles of the base of the tongue in front of the epiglottis and primitive larynx to the upper part of the trachea.

In the descent, the pouch is drawn out into a tube-like form, known as the thyroglossal duct, which is normally obliterated during fetal life. The mass is now solid, but spaces appear and later become filled with vascular and lymphoid tissue, which ultimately splits the thyroid epithelium into layers of about two cells in thickness.

The concomitant development of the larynx divides the thyroid into two lobes connected by an isthmus. A little later, the layers of cells become separated by a clear substance; finally, a capsule of fibrous connective tissue gradually envelops the mass.

The developed gland lies across the trachea, to which it is loosely attached. The lobes are convex externally and concave internally; the upper poles are conical and the lower rounded. The mean weight of the gland is about 26.11 gm. The right lobe is usually the larger and is also situated higher in the neck than the left.

## SURGICAL PROBLEMS

Without further discussion of the anatomy, physiology and pathology of the

thyroid gland, I wish to consider the surgical aspects of the problem of goiter together with the preoperative and postoperative care, form of anesthesia, surgical technic and results of thyroidectomy.

## PREOPERATIVE USE OF IODINE

The use of iodine in any form of Graves' disease was formerly supposed to be contraindicated, because it was believed that its use increased the severity of the symptoms and might, in fact, be responsible for the development of exophthalmic from simple goiter.

Plummer, of the Mayo Clinic, in 1922 began the use of Lugol's solution as a preoperative measure in the treatment of exophthalmic goiter. Ten minims of Lugol's solution were given three times a day for the first ten days and continued up to the time of operation and throughout the postoperative reaction, even though the period before operation might be prolonged for several weeks. After the postoperative reaction, 10 minims daily were given as a routine for eight weeks.

If a crisis occurs, Plummer advises the administration of 50 to 100 minims in divided doses orally or by rectum within one or two hours. By this preoperative use of Lugol's solution, the surgical mortality was reduced from 3.5 per cent to 1 per cent and the preoperative mortality from 2.5 to 3, to 0.2 to 0.5 per cent.

From this time (1922) to 1926, various other observers (Boothby, Mason, Starr and Means, Read, Clute, Merkle and Helmholtz, and Holst and Lunde [1929]) employed iodine in the preoperative treatment of goiter and found it beneficial.

There is still, however, great diversity of opinion as to the manner in which Lugol's solution acts; but there is ample

\* From the Surgical Section, DeCourcey Clinic. Submitted for publication May 13, 1930.

clinical evidence that its preoperative use in exophthalmic goiter is a safe and beneficial measure, which controls the symptoms, lowers the metabolic rate and lessens the hazards of operation.

When such preoperative treatment is administered, at operation the thyroid gland is found to be edematous. When the gland is sectioned, a watery fluid exudes freely from the incised surfaces. This condition is not found in those cases not treated with Lugol's solution or in the ordinary colloid goiter. This observation has led me to believe that the beneficial effects of preoperative iodine medication are due to a rapid formation of colloid material in the thyroid gland, which is depleted of its normal iodine content. Back pressure from this formation results not only on the cells and acini but also on the thin-walled veins surrounding the acini, and it is this back pressure that causes the passive edema found at operation. The edema of the gland in turn renders the secreting cells inactive, and the absorption of toxic substances is thus prevented; hence, the improvement in the patient's condition.

However, the temporary nature of the improvement can be accounted for by the fact that new blood vessels are formed and the older ones accommodate themselves to the changed condition. Absorption then recurs and the patient becomes toxic, even though colloid formation in the gland may still persist. Marine, who has studied the effects of administration of iodine experimentally, has reached a similar conclusion.

At the DeCourcy Clinic, it is our practice in cases of hyperplastic and adenomatous goiter to administer 10 drops of Lugol's solution three times a day for from two to four weeks preceding the operation, depending upon the degree of clinical improvement and the change in the gland itself, as checked by metabolic readings. In cases of severely toxic adenomatous goiter with cardiac instability or decompensation, patients are placed in bed in the hospital and given a course

of digitalis therapy. If there is neither irregularity of beat nor decompensation, 3 doses of standardized tincture of digitalis of 30 minims each are given at intervals of eight hours. If cardiac arrhythmia is present, 10 drops of tincture of digitalis are administered three times a day until compensation is restored. Digitalis is usually discontinued about five days before operation and resumed immediately afterward.

Jackson believes that the surgical treatment of exophthalmic goiter has been revolutionized by the preoperative use of iodine; but he also points out the surgical risk, while admitting the reduction of the surgical mortality to 1 or 2 per cent or less.

Graham states that, while all the phenomena observed after the administration of iodine in toxic goiter are not understood and cannot be satisfactorily explained, its preoperative use is justifiable because of the beneficial effects which have been abundantly proved by clinical experience.

The quantity of iodine necessary to effect the maximum of clinical improvement is determined largely by the size of the thyroid gland and the degree of active hypertrophy and hyperplasia at the time treatment is instituted. Excessive dosage over prolonged periods of time deprive the patient of the valuable therapeutic aid in preparing him for operation, unless there has been an interval of at least a month before its resumption as a preoperative measure. A thrill and bruit over the gland are sufficient indications for resumption of treatment, and complete involution of the thyroid indicates that sufficient iodine has been given and its further use will not likely prove beneficial. However, the drug should not be discontinued immediately preceding operation.

It is doubly important to insist upon preoperative rest and treatment with Lugol's solution when performing thyroidectomy on patients with psychoses, because of the danger of increasing the mental symptoms by a period of exacerb-

ation that might otherwise follow immediately after operation.

#### ANESTHESIA

Good judgment is required in the choice of a method of anesthesia in goiter operations, and a safe anesthesia is one of the most important factors in the lowering of the mortality rate in such operations. The relative freedom from postoperative hyperthyroid crises is attributed by Pemberton to the avoidance of prolonged general anesthesia and the adoption of special methods of anesthesia as well as to improvement in technic and the pre-operative use of iodine.

Crile has adopted the use of nitrous oxide and oxygen with local infiltration almost as a routine in goiter surgery.

Heyd and Smith have employed rectal anesthesia in cases of Graves' disease of severe type. Rectal anesthesia is also used in adenoma hyperthyroidism, but in all other goiters ethylene gas is used.

Pitkin has recommended the use of ephedrine combined with novocaine in block anesthesia as a safe and effectual anesthesia for thyroidectomy. While I have employed spinocaine (Pitkin's method) in over five hundred operations below the diaphragm, and with satisfactory results, I am convinced of the superiority of nitrous oxide and oxygen anesthesia in goiter operations.

Kocher completes the operation under local anesthesia and attributes his low mortality to this method. Bartlett believes the ideal anesthesia for goiter operations is novocaine infiltration and nitrous oxide or light ethylene inhalation. Gwathmey has stated that, when general anesthesia is to be employed, ether and chloroform with oxygen by tube is probably the best method. I do not agree with this conclusion; but with his statement that "those who have never used oxygen with nitrous oxide, and who have acquired the technic of administering it alone, will be surprised by the ease and latitude given by this combination," I do agree.

Some six thousand goiter operations

have been performed at DeCourcy Clinic during the past ten years, and several methods of anesthesia have been used.

Five hundred patients were operated upon under local anesthesia. The skin incision, the cutting of muscles and the division of the capsule could be satisfactorily accomplished; but, when the gland was elevated from its bed and the capsule stripped back, there was almost invariably complaint by the patient of a sensation of being strangled. While no pain is felt in many instances, the psychic shock is always undesirable, the time consumed for the operation is usually twice as long as under general anesthesia, and the nervous tension suffered by the surgeon is considerable.

Ether by the open drop method was given to patients who objected to local anesthesia; but it had the disadvantage of a stage of excitement, deep narcosis, postoperative nausea, and disagreeable effects upon the surgeon and his assistants.

Local infiltration combined with nitrous oxide induction and light ether sequence was found quite satisfactory for a time.

About five years ago, however, I began the use of nitrous oxide and oxygen anesthesia for all goiter operations and soon discovered that this method has many advantages. Anesthesia is induced rapidly and recovery is almost immediate, the patient usually becoming conscious before leaving the operating table. Vomiting and retching are reduced to a minimum, and the danger of postoperative hemorrhage is almost completely obviated. The dosage of the anesthetic agent can be regulated to suit the needs of the patient. Injury to nerves can be detected readily by the respiratory rate and crowing inspiration which occurs under this light anesthesia. There is no excess of mucus and sufficient rigidity is present to prevent the falling backward of the tongue and consequent obstruction of respiration. Anesthesia can be deepened quickly, if necessary, and the patient can also be brought back to a safe level by administration of pure oxygen under direct pressure.

While nitrous oxide and oxygen anes-

thetia with proper preliminary medication appears to me to be the method of choice for thyroidectomy, the anesthetist should be skilled in both local and general anesthesia and prepared to administer such anesthetic agents as will produce a well-balanced anesthesia with a minimum of untoward results prior to, during and following the operation.

#### TECHNIC OF OPERATION

Without doubt, the successful treatment of toxic goiter must be by thyroidectomy. Medical measures are generally of only temporary avail. They find their greatest field of usefulness in preoperative and postoperative care.

Gentleness of manipulation is of first importance in surgical technic. In fact, the actual steps in the operation are overshadowed in importance by preoperative and postoperative medication with Lugol's solution and the choice of the anesthetic.

In milder cases, a one-stage bilateral partial lobectomy may be performed. A low, transverse collar incision, following the wrinkle of the neck, leaves an inconspicuous scar, which women may hide completely by wearing a necklace. The wound may be closed without drainage if there is no oozing.

In very large hyperplastic thyroids, especially in gangrenous, a two-stage operation is desirable. The thyroid gland is exposed and, after polar ligation, single partial lobectomy performed. If the patient's condition permits, the operation is completed twenty-four to forty-eight hours later.

In all cases, if thyrotoxicosis is to be relieved completely, not less than four-fifths of the entire glandular substance must be removed.

During the course of the operation, the principal accidents against which we must guard include primary or secondary hemorrhage, surgical shock, collapse of the trachea, injury to the parathyroid glands or to the recurrent laryngeal nerves, and air embolism through the large veins of the neck. With careful technic, these

accidents are not likely to cause serious trouble.

#### POSTOPERATIVE TREATMENT AND RESULTS

There is a remarkable improvement in the convalescence of patients who have been treated preoperatively with Lugol's solution, absence of tachycardia, muscular tremor, restlessness and fever. In all toxic cases, the patient is given 30 minims of Lugol's solution rectally, as soon as he is returned to bed, and the dose repeated in about eight hours. In severe cases of exophthalmic goiter, a third dose may be required; but this is rarely necessary when the patient has been prepared properly.

Fluids are given subcutaneously and encouraged by mouth, if they do not cause nausea. In the adenomatous gland, iodine has not been of especial value in the preoperative treatment but has been of distinct value postoperatively.

In a series of 388 operations, 92 per cent of which were upon patients with toxic goiter, there was but one death. This reduces the mortality for the year (1929) to  $\frac{1}{4}$  per cent, a notable improvement over several years ago.

Six cases of hyperplastic goiter were complicated by diabetes mellitus. The patients were prepared for operation by administration of Lugol's solution and insulin and a restricted carbohydrate diet until they were sugar-free. The operations were performed without difficulty and convalescence was uneventful.

Operation alone is not a cure for these patients. The after-care is most important. Skillful nursing, large doses of iodine, warmth and sedatives are necessary. The intelligent coöperation of the patient not only for months, but for years, is an essential for a favorable prognosis.

#### THYROIDECTOMY FOR MENTAL DISTURBANCE IN ASSOCIATION WITH GOITER

Berkeley and Follis observed a marked resemblance between the symptoms of exophthalmic goiter and those of the catatonic form of dementia precox. During the prodromal stage of catatonia, there was a

similarity of mental symptoms to those occurring in Graves' disease. There were also tachycardia, loss of weight, excessive sweating, fine tremor of the fingers, quick pupillary reflexes, vasomotor weakness and menstrual anomalies. The thyroid gland was not usually enlarged, but was of a soft mushy consistency and contained occasional hard nodules.

The administration of iodine, iodothyrene or desiccated thyroid extract caused a temporary cessation of stupor. These observers performed partial thyroidectomy in 10 cases of catatonia; 4 of these patients recovered their mental equilibrium and 3 improved slowly but progressively with no tendency towards relapse.

Other investigators (Kanavel, Winslow and Weinberg) have confirmed the work of Berkeley and Follis. It must be understood, of course, that there is no attempt to ascribe an etiologic relationship of disturbances of the thyroid gland to the average case of dementia precox; but, in occasional cases, there is a close relationship between dementia precox and thyroid disease.

During the past five years, I have operated upon 14 insane patients with Graves' disease, 12 of whom have made complete mental recoveries and remained normal to date. In 13 of these patients, there was a hyperplastic goiter.

Mental improvement seldom occurs immediately after thyroidectomy but is more commonly gradual, during a period of from several months to a year.

The coexistence of mental disease with exophthalmic goiter does not contraindicate operative procedures, but makes them more advisable, since they offer a fair prospect of mental recovery.

#### CONCLUSIONS

1. The successful treatment of toxic goiter and the safe one, because it spares the heart and nervous system undue stimulation, is by thyroidectomy.
2. Modern methods of surgical treatment have not only improved results but also greatly lessened the mortality, to less than  $\frac{1}{4}$  per cent at the DeCourcy Clinic.
3. Of first importance is preoperative and postoperative use of Lugol's solution.
4. Second in importance is the choice of the anesthetic. I regard nitrous oxide and oxygen, administered by a skilled anesthetist, as the procedure of choice.
5. By way of technic, extreme gentleness in handling the gland at operation and the use of a two-stage operation in severe cases are essential.
6. In mentally disturbed patients having toxic goiters, thyroidectomy offers a fair prospect of recovery from mental symptoms.

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# HYPERNEPHROMA, PAPILLOMA AND STONE

## OCCURRING IN HORSE-SHOE KIDNEY\*

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**T**UMORS of the kidney are frequently encountered and hypernephroma is the most common of them all. Abnormalities of the kidney are also common and of these the horse-shoe type is well known. Papilloma of the renal pelvis is likewise frequently met. As for calculus, the condition was known to the ancients and is now encountered almost daily in medical practice. However, I feel that all four of these conditions occurring in a single case is rather unusual and is of sufficient interest to justify this report.

### HISTORY

Hypernephroma (so-called) makes up about 85 per cent of renal malignancies. Duffield<sup>1</sup> reports that 87.5 per cent of 25 cases of renal tumors treated at Mt. Sinai Hospital were hypernephromata and according to Albrect<sup>2</sup> 28 out of 32 cases represented this type of tumor.

The typical horse-shoe kidney occurs in about one of a thousand autopsies according to Morris.<sup>11</sup> Renal calculi were found by Kraft<sup>3</sup> (quoted by Keyes) forty times in 2953 autopsies.

Eisendrath<sup>4</sup> has collected 30 cases of horse-shoe kidney, 7 of these patients being operated upon for stone. In the same 30 cases tumor occurred but once and there were no instances in which tumor and stone occurred together.

Stone and tumor are found together, however, and in some cases the tumors are sequelae of antecedent stones. Noteworthy among the cases reported which prove this point are those of Bugbee<sup>5</sup> and Wells.<sup>6</sup>

Primrose<sup>7</sup> in 1920, reported his case of squamous cell carcinoma complicated by calculous pyonephrosis in a horse-shoe kidney. He felt that there was first an

irritation set up by the stone and that consequently villous formation occurred in the pelvis and finally malignancy developed by a process of metaplastic changes.

That hypernephromata originated in adrenal rests or groups of cells of adrenal origin which were found in the kidney as well as in other parts of the body, was suggested by Grawitz<sup>8</sup> in 1883.

Stoerk<sup>9</sup> in 1908, claimed that these tumors were of renal origin developing from the renal tubules.

An article on The Origin of Hypernephroma of the Kidney was published by Fraser<sup>10</sup> in 1916. It is here shown that they may be of either renal or adrenal origin. He has demonstrated that the primary structure of tumors of renal origin are different from those of adrenal origin, but that secondary degenerative malignant changes make their histological features similar.

### DIAGNOSIS

At one time the diagnosis of horse-shoe kidney was difficult to make preoperatively but since the advent of pyelography it is made much more rapidly. The characteristic points in the diagnosis are:

1. Both kidney shadows are lower than normal.
2. The pelvis and ureters are closer than normal to the midline and rotated.
3. The lower calices point centrally.

### CASE REPORT

Mr. L. H., aged fifty-seven, came to see me in May, 1929, complaining of bloody urine. Further questioning proved that he had also had attacks of rather severe pain in the back on the left side over a period of four years. The bleeding had been present only during the past month. His prostate was not enlarged and there was no residual urine, so a cystoscopy

\* From the James Buchanan Brady Foundation for Urology of the New York Hospital.

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FIG. 1. Plain x-ray. Shadow about the size of walnut indicates presence of stone in left kidney region.



FIG. 2. Left pycelogram. Large distorted pelvis in same field as stone shown in Figure 1. Lower calices point centrally, indicating horseshoe kidney.



FIG. 3. Left pycelourterogram. Moderate dilatation of ureter. Lower calices better outlined than in Figure 2.

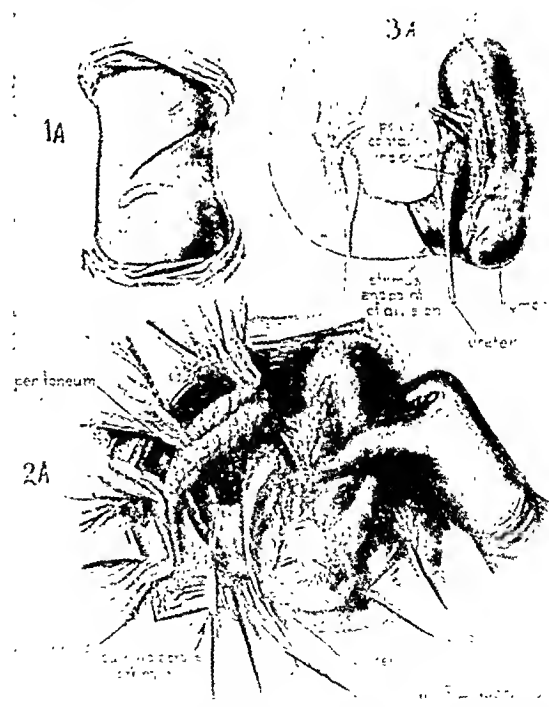


FIG. 4. 1A. Incision begins at point just below middle of last rib and curves downward and laterally to point above anterior superior iliac spine. 2A. Exposure of left side of horseshoe kidney. Tumor is seen at lower pole. Ureter has been ligated and cut. Isthmus is cut across, freeing left side from right. 3A. A thick band of tissue connects right and left kidneys at their lower poles.

was done and a complete urological examination was made.

The bladder appeared normal and no bloody

	PHENOLSULPHONEPHTHALEIN	
	Right	Left
Appeared	five minutes	nine minutes



FIG. 5. Plain x-ray and pyclogram of specimen after removal. Outline of tumor is here plainly visible.

urine was seen coming from either ureteral orifice. No. 6 lead catheters were passed and specimens were collected for culture, urea determination and microscopic examination. The cultures were negative, the microscopic examination of the sediment showed blood and pus, diminished urea and phenolsulphoncphthalein output on the left side.

REPORT OF URETERAL SPECIMEN

	Right	Left
Character	bloody	bloody
Urea	25 gni. per liter	16 gni. per liter

Per cent	9.5 per cent	trace
Time	ten minutes	ten minutes

MICROSCOPICAL EXAMINATION OF SEDIMENT

Wet Specimen	Many R.B.C.	R.B.C. 200+ pus cells in clusters
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Plain x-rays as shown in Figure 1, showed a shadow about the size of a walnut in the left kidney region indicating the presence of a stone and a pylogram confirmed the position of the stone and showed the kidney shadow to be low in position, its pelvis and ureter near the midline and the lower calices rotated and



pointing centrally. No filling defect could be seen (see Figs. 2 and 3).

Upon this evidence, and with the assurance

but with tumor as well. The tumor was about the size of a small tangerine, and was situated in the lower pole of what proved to be a typical



FIG. 6. Artist's drawing. Anterior and posterior aspects of specimen.

that the function on the right side was adequate, the left kidney was exposed with the intention of doing a pyelotomy or nephrotomy for stone.

#### OPERATION

An incision was made from a point over the middle of the twelfth rib curving downward



FIG. 7. Specimen split longitudinally. Tumor is well encapsulated.

and laterally to a point above the anterior superior spine of the ileum (Fig. 4, 1A). The perirenal veins were engorged and as the kidney came more fully to view it was apparent that we were dealing not only with calculus



FIG. 8. Drawing. Papilloma is seen in the pelvis. Calculus has been removed and is drawn to scale.

horse-shoe kidney with a thick band of tissue running toward the opposite side and connecting with the opposite kidney (Figs. 4, 2A and 3A).

The ureter was identified, ligated, cut and cauterized. Many aberrant vessels were encountered and ligated. Because of these vessels, the pedicle was clamped with two large kidney clamps, doubly ligated and cut. The isthmus was also clamped and cut, and a pad of fat sutured over the severed edge. Drains were inserted and the wound closed in layers.

A pyelogram was now made of the specimen which had been removed. This pyelogram showed not only what the preoperative plates had showed but the filling defect made by the tumor as well (Fig. 5).

The patient's convalescence was uneventful except for a rather high immediate postoperative temperature ( $104^{\circ}\text{F.}$ ). The wound drained pus copiously for several weeks and finally closed completely two months after operation. He is now alive and well and up to the present time has had no return of his previous symptoms.

#### PATHOLOGY

Specimen consists of a portion of horse-shoe kidney containing a tumor nodule approxi-

mately 4 cm. in diameter (Fig. 6). The kidney has been subsequently split longitudinally (Fig. 7). The upper pole is of normal outline.



FIG. 9. Moderate pyelonephritis. Distortion of tubules and glomeruli with leucocytic infiltration.

The ureter appears to be derived and situated normally. The pelvis is moderately distended and its mucosa extends to involve the calices which are somewhat flattened. A stone is present in this area and immediately below it the pelvis is thrown into irregular papillomatous folds (Fig. 8).

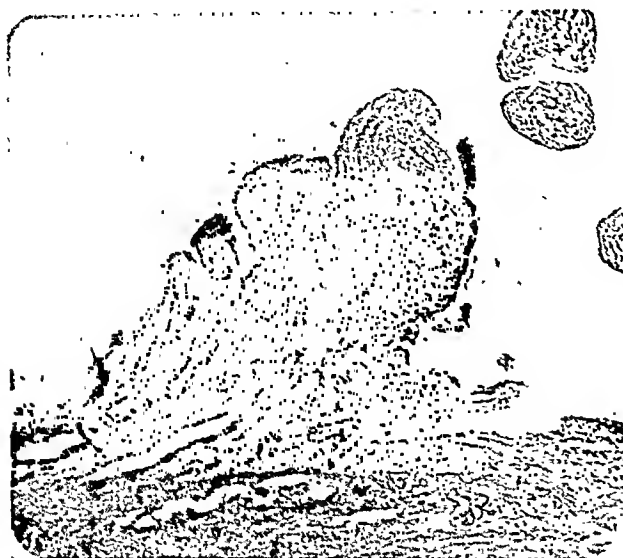


FIG. 11. Benign papilloma.

The main tumor has the general appearance of the so-called hypernephroma, an eneapsulated tumor, with a dense fibrous core and radiating fibrous trabeculae of nearly cartilaginous consistency. It is yellowish and red in color, further suggesting the lipochrome or lipid filled cells of this type of tumor and the

usual complicating hemorrhage. No invasion of the surrounding kidney substance or of the vessels is found.



FIG. 10. Papillomata are of multiple benign type.

Sections microscopically through the kidney tissue show a moderate pyelonephritis in the region of the pelvis (Fig. 9). The papillomata in the pelvis are of the multiple benign type some showing a definite connective tissue stalk and some being of the sessile type. All have a typical and orderly arrangement of cells. The tumor itself is made up of large sheets and

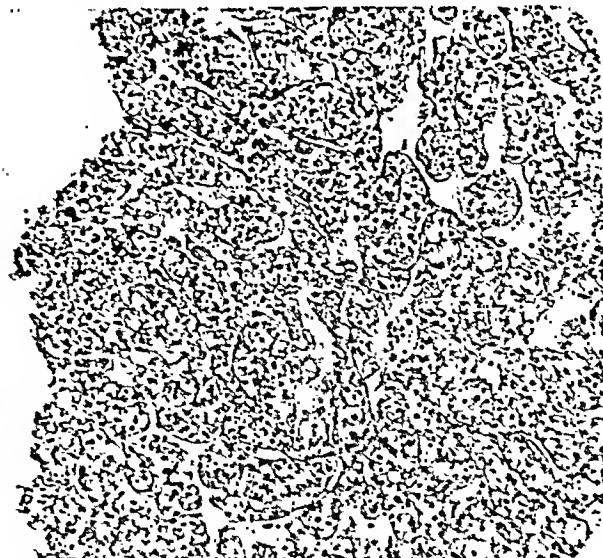


FIG. 12. Hypernephroma. Large sheets and trabeculae of polyhedral cells with small deeply staining nuclei and pale cytoplasm. Some cells are arranged in alveolar fashion.

trabeculae of polyhedral cells containing relatively small and deeply staining nuclei. The cytoplasm is of the type described as foamy. It is very pale and finely vacuolated. Scattered

here and there are found areas where the cells are arranged in alveolar fashion with a definite central lumen. There is extensive degeneration

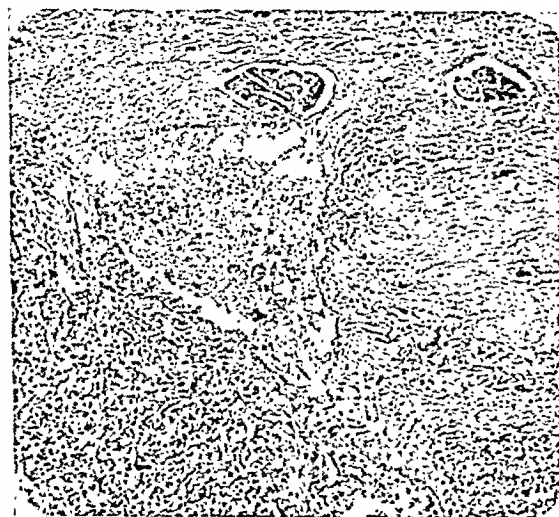


FIG. 13. Line of demarcation between tumor and kidney tissue.

and hemorrhage throughout the specimen. This alveolar arrangement is very suggestive of the so-called clear cell tumors, presumably of renal tubule origin (Figs. 10, 11, 12, 13).

From a prognostic standpoint it appears relatively benign, with few mitoses and no evidence of capsule or vessel invasion.

#### DISCUSSION

In general it may be said that this group of so-called hypernephromata are of three chief types: First, the tumors with clear cells arranged in alveoli or tubules, tending to show papillary hyperplasia and usually credited with being histogenetically renal in origin, the renal adenocarcinoma; second, the typical, relatively solid Grawitz tumors, showing no true alveoli and usually conceded as arising from adrenal rests; and third, the intermediate group in which these distinguishing characteristics are not well defined and which seem to merge histologically. It is in this intermediate group that this particular tumor must be classified, illustrating the difficulties of a satisfactory classification on the basis of histogenesis. As a generic clinical term, hypernephroma

is probably as accurate a label as any which can be attached to it.

It is not uncommon to find stones in horse-shoe kidneys; in fact, they seem predisposed to become complicated by this condition because of the abnormal position of their pelvis and the abnormal course of the ureters, producing poor drainage.

There does not seem to be quite the definite relationship between the stone, the papillomata and the main tumor in this case that holds in the case reported by Primrose,<sup>7</sup> for whereas it seemed possible for the squamous cell carcinoma, reported by him to be a final result of metaplasia from a tumor originally growing in the pelvis, here the tumor is definitely circumscribed and situated in the lower pole at some distance from the papilloma.

The histogenesis of this case is difficult to determine because the primary structure of the tumor could not be definitely made out, and although there were areas that suggested tubule formation they were not definite enough to state conclusively that this tumor is of renal origin.

A preoperative diagnosis of horse-shoe kidney with calculus in the left pelvis was made. The tumor was not discovered until the time of operation. Hindsight is better than foresight and the filling defect was made out even in the original pyelogram when the presence and position of the tumor had been made clear at operation.

Heminephrectomy of a horse-shoe kidney does not differ greatly from ordinary nephrectomy, the main differences being that it is more difficult to expose, that there is more likelihood of meeting anomalous vessels and that an added danger from hemorrhage is present because of the incised tissue at the isthmus.

I wish to express my thanks to Dr. O. S. Lowsley for his assistance at operation and for permitting the report of this case from the James Buchanan Brady Foundation. I also wish to thank Dr. L. W. Smith for his description of the pathology.

[For References see p. 468.]

# FISTULAE OF THE ABDOMINAL WALL\*

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IT is difficult to comprehend why there is such a great sparsity in the literature concerning fistulae of the abdominal wall. Every surgeon at one time or another must have been confronted with this problem. Therefore it is of the utmost importance that the prophylaxis, treatment and prognosis of this complication be thoroughly understood. A résumé including the presentation of a few personal observations is our object.

A classification which is simple and yet embraces all types of abdominal fistulae may be outlined as follows:

A. Fistulae to the abdominal wall, more common.

B. Fistulae between two viscera, uncommon.

The latter type, the course of which usually terminates in spontaneous closure, will not be discussed here, nor will we consider fistulae of the genitourinary tract. In the majority of cases, those coming under Class A, either result spontaneously or follow enterostomy. Preoperative indications are, paralytic ileus, intestinal obstruction and peritonitis, or wherever there has been excessive handling of the bowel, i.e., the expectation of poor intestinal response. In all cases other than those due to enterostomy, the formation of the actual fistula is the result of inflammatory processes. These pathological changes occur as follows:

The involved area becomes circumscribed by the "first line of defense," i.e., a leucocytic and fibroplastic barrier whose purpose is localization. The serosal surface of the gut in contact with the inflammatory processes is exposed to degenerative changes which eventually terminate in ulceration and perforation. Thereby is established the internal opening of the fistulous tract; in short, fistulae form where the circulation is impaired.

Cicatricial contraction is coincident with and follows the absorption of the inflammatory products. The end-result tends towards a fistulous tract lined by fibrous walls. A serous, mucous or purulent exudate is usually found within the lumen of the fistula. In the majority of cases, the outer circumference of the intestine is in close proximity to the parietal peritoneum lining the anterior abdominal wall. Therefore the fistulous tract is usually a short one. However, other possibilities are, a long tract, or multiple orifices in the gut which may be large or small. Without suitable treatment the abdominal opening undergoes retrogressive changes. Digestion of the muscle wall with extensive excoriation and ulceration of the skin usually result coincident with a rapid enlargement of the abdominal orifice. The higher up in the gastrointestinal tract, excluding stomach, the greater the excoriation and ulceration. Contrary to the prevalent conception, fistulae low down in the intestine discharge pancreatic juices and ferments although to a lesser degree. Gastric and biliary fistulae usually heal spontaneously and are not accompanied by the systemic symptomatology seen in the conditions being described. Once the fistulous tract is established, the discharge becomes profuse and consists of feculent material mixed with intestinal secretions and serous, mucous or purulent exudate. Experience has shown that fistulae of the small bowel heal extremely slowly or not at all, while those of the large intestine invariably close spontaneously with the assistance of ordinary measures. In other words, the higher the origin, the less likelihood is there of spontaneous closure.

The diagnosis of fistula is obvious. Fecal material continually contaminates dressings which require constant changing.

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Natural bowel movements are absent, or occasional and scanty. The patient rapidly loses weight and becomes pro- enzymes are able to act. Therefore in order to combat this chemical action on the tissues of the abdominal wall, hydro-



FIG. 1.

FIG. 2.

FIG. 3.

nouncedly weak due to the profuse drainage from the fistula. This illustrates the loss of food intake essential for body nourishment. Fluids and body salts are greatly depleted. Consequently the thermal balance is disturbed and the occasional or daily rises in temperature are present in most cases. Another cause for elevation of temperature is local suppuration with septic absorption. The systemic toxemia is also in great part due to the loss of body chlorides. Starvation is less pronounced the more distal the fistula. To recapitulate, the picture is one of toxemia of varied degree necessitating active treatment in conjunction with care of the local condition.

Fistulae of the abdominal wall are treated as follows:

- A. Non-operative:
  1. Dressings, local applications, etcetera.
  2. Diet and medication.
- B. Operative, the last resort.

We have found the C. A. Potter treatment of great value. The rationale of this treatment is based on the fact that pancreatic juices resist healing of the wound. It is only in an alkaline medium that the

chloric acid is used to neutralize the alkaline discharge. Since complete neutralization is not possible, protein is added to counteract the effect of the proteolytic and other ferments. Decinormal hydrochloric acid is used, this being the concentration present in the normal gastric juice. A convenient form of protein is concentrated beef extract. Olive oil is added to counteract bile and lipase. The Potter treatment is summarized as follows:

- A. Dress wound every two hours.
1. Cleanse area with alcohol. Dry.
2. Apply tenth-normal hydrochloric acid on a pledget tamped loosely into bottom of crater of the fistula.
3. Cover with gauze dripping of prepared mixture of beef extract and olive oil.

The beneficial effects of this treatment are evidenced in twenty-four hours. Excoriation of surrounding skin and the volume of the discharge are markedly diminished. Progress is rapid.

We have used this treatment with good results in 4 recent serious cases. The illustrations, Figures 1, 2, and 3, are representative of the rapid improvement.

experienced. The photographs were taken at weekly intervals, the Potter treatment being instituted in the interim. Warsaw and Hoffman have modified Potter's method by the use of a continuous drip, 5 c.c. per half-hour of decinormal hydrochloric acid and 10 per cent Witte's peptone. One catheter, that used to pass the acid, leads to the fistula; the other serves to soak the gauze with peptone mixture. They claim that the value of this modification is that the patient is not disturbed and the treatment is continuous. Potter's statistics show healing of upper intestinal fistula ranging from three to six weeks. H. Eckstein reports good results with the use of suction. This applies where the etiological factor may have been a foreign body, necrotic tissue, non-absorbable suture material, et cetera. The removal of such bodies by suction apparatus has been followed by rapid cure. There are others who claim the advantage of frequent irrigations with mild antiseptics in conjunction with packing and allowing healing by granulations from within outwards. Our own observations have proved the efficacy of a plug (gauze) in the fistulous opening. This serves to direct the flow of intestinal contents in the normal direction. In all of our cases this procedure has been followed shortly by natural bowel movements. Further treatment of the local condition should consist of the application of heat to the exposed wound, the therapeutic lamp or the ultra-violet ray being used.

Operative treatment is indicated where these methods have failed, or where the patient is rapidly starving or becoming uncontrollably toxic. Tuberculous tracts as a rule necessitate operative interference. Mayo favors excision of the fistula followed by purse-stringing the aperture in the gut. It is often found necessary to resect a portion of the intestine where the enteral opening is too large or where the gut shows sufficient pathology.

It is important to emphasize the necessity of prophylaxis in the prevention of fistulae. The peritoneum and bowels should not be handled unnecessarily, thereby avoiding adhesions. Care must be exercised that no foreign body-feces, non-absorbable suture, gauze, et cetera, be left in the peritoneal cavity. Hard drainage tubes are also a source of danger. These may cause impairment of circulation in the intestine by pressure contact.

#### SUMMARY

1. Fistulae of the abdominal wall leading to the gastrointestinal tract unfortunately are not uncommon.
2. Non-operative treatment will cure the great majority of these cases.
3. A plug in the fistulous opening is of greatest importance in the non-operative treatment.
4. The C. A. Potter method has proved efficacious.
5. Fistulae to the lower bowel nearly always heal spontaneously.

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# COLONIC THERAPY\*

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THERE are few problems in physical therapeutics that have given rise to a greater diversity of opinion than colonic irrigation. Some would cure nearly every disease with this, while others would go better and actually defer old age. Another camp looks upon the whole problem with suspicion. In our own work we paid little attention to this matter for a number of years and when we did take up the problem we met with difficulties that readily explain the bad reputation this treatment has with physicians. For instance, if we select an apparatus necessitating the use of the cecal tube, we will find the procedure tedious, difficult and time consuming and oftentimes unsatisfactory and indeed not without danger. Some of the modifications using a two-way tube may be more simple but the results are not so good. Both these types of apparatus make it necessary for the patient to disrobe and necessitate exposure of the parts which is objectionable in all instances. Then the treatment is given with the patient in a recumbent position and this makes it difficult to avoid soiling the table and in many other ways the difficulties are such as to discourage the most enthusiastic operator. Nevertheless if one does persist and give thorough treatments the results obtained will oftentimes well repay the effort. Our aim has been to simplify the technic of this procedure, if possible, and to do away with some, if not all the disagreeable features. One of the first things we learned in studying this problem was, that evacuation and lavage of the colon in a patient in a recumbent position and one in the sitting posture are entirely separate and distinct problems. With a patient lying down the normal mechanism for moving the bowels is almost entirely out of play and the

apparatus must in a large measure make up for this deficiency. It is not so with a patient sitting up. This is the natural position for this function and excellent results can be obtained by assisting nature rather than substituting an almost entirely artificial process. We have found the difficulties of colonic lavage in a patient in the recumbent position so numerous and difficult to overcome, that we have practically given up the procedure.

Our first indication for colonic lavage was for preparing patients for operation. Every surgeon encounters at the operating table patients with the colon, specially the cecum, filled with large hard masses. During the few days that follow operation these have to be removed by repeated enemata at the expense of a lot of time and effort on the part of the nurse and untold discomforts to the patient. If the night before the colon is thoroughly evacuated and washed, at operation the large bowel will be found about half the usual size and oftentimes the simple Trendelenburg position will empty the pelvis, obviating the necessity of using packs. After the operation, no attention to the bowels will be necessary for three or four days and then a simple enema will accomplish the desired results. We aim first to empty the whole colon; of course an enema will empty the rectum and sigmoid but this is not sufficient; the transverse colon and cecum must be emptied as well. Then, irrigation or lavage becomes not only possible but easy and whatever virtue there may be in this procedure, can readily be made obvious.

The apparatus we have developed consists of two models, one portable which we presented elsewhere<sup>1</sup> and the hospital model presently described. The principle

<sup>1</sup> *Am. J. Phys. Therapy*, February, 1930.

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of both is the same and the advantages of the one are that it can be carried in the doctor's bag or used in the patient's home while the other is specially adapted to hospital use where a number of treatments are given daily.

The instrument is made entirely of plated brass and consists of a tube 22 in. long bent in such a way as to readily adapt itself to the conformation of the body and with a removable tip of varying size and handle by which the instrument can be manipulated. In the case of the hospital model the instrument is connected to a 3 gal. reservoir suspended 7 ft. from the floor and connected by a tube and controlled by a valve.

*Technic:* This is very simple. No preparation of any kind is necessary and the contraindications are such as would apply to an ordinary enema. With the patient sitting on a standard toilet seat, the tip, thoroughly anointed with vaseline is gently introduced through the anus by the patient himself by sense of touch only, without exposure of the parts. When the tip has passed into the rectum the sphincter closes about the tube and all is ready for introducing the liquid. The sense of touch of the rectal mucosa is poor and one scarcely perceives the presence of the instrument. The liquid is forced into the rectum by hydrostatic pressure controlled by the valve in the tube until a sense of fullness with a desire to move the bowels is experienced; the sphincter is then relaxed and the abdominal muscles contracted and the bowels moved in a very nearly natural manner without removing the tip which should remain in place throughout the treatment and without shutting off the supply of liquid. When evacuation has taken place the sphincter contracts again around the tube and the process is repeated until such time as the colon has been completely emptied and washed with soap and water. This should all be done gently and slowly. The tip is then removed by the patient and the colon, instrument

and toilet will be found thoroughly clean for being washed with a large quantity of cleansing fluid. For ordinary purposes

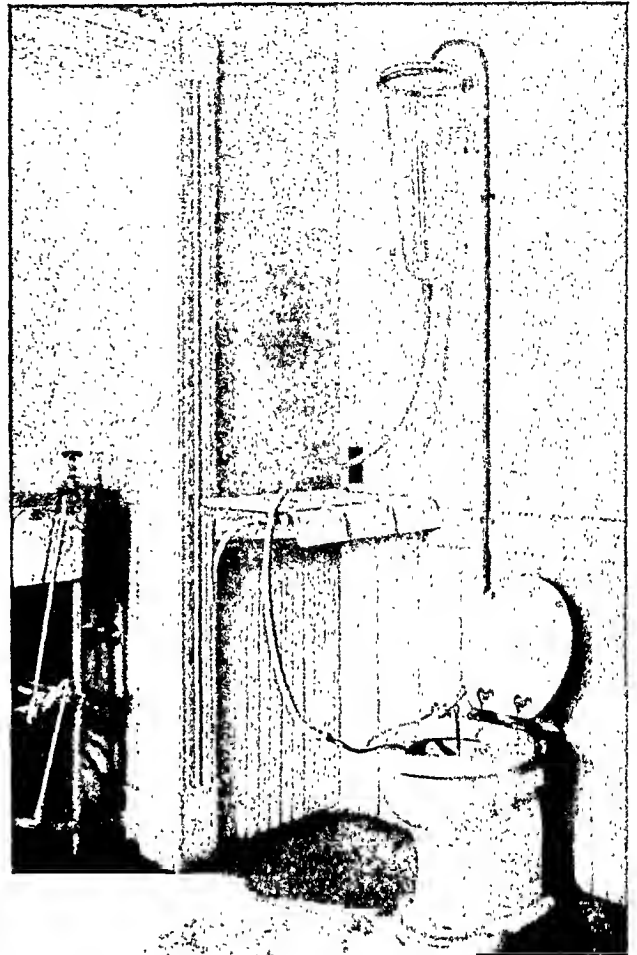


FIG. 1.

soap and water are all that are necessary but glycerin an ounce to the gallon may be added to increase the effect or any other medicament added as desired as with an ordinary enema. The standard quantity of soap is 2 oz. of castile soap to the gallon and this should always be dissolved first by boiling. No solid should ever be added directly to the water in the reservoir for if it is heavier than the water it will pass out first and might reach the colon in too high concentration. It is well to use cool water towards the end to prevent congestion of the rectal mucosa. Five gallons are the usual quantity of soap and water necessary although two or three times that much can be used.



While the apparatus was primarily intended to give colonic irrigations we found it so convenient that we used it for giving enemata which differ only in the quantity of liquid used. We have the apparatus in a special room and the reservoir is connected with hot and cold water. For an ordinary patient with this equipment it takes about one-half hour to secure a thorough cleansing of the whole colon. There is no pain or discomfort and if used with ordinary care there is no danger. We have given over a thousand treatments without accident.

Some men have questioned that the whole colon could be washed with this type of apparatus and we find stated in the literature that it is only with a tube introduced into the cecum itself that this can be accomplished. Any physician can test this for himself by giving a barium enema before the treatment. When a mixture of soap and water is forced into the rectum and sigmoid under sufficient pressure the bowel is distended and made to contract and if expulsion is resisted at the sphincter and the wave will turn and move up the colon and in this manner will pass over the splenic flexure and

eventually reach the transverse colon and cecum. It certainly should be as easy to introduce soap and water into the cecum as it is to insert a tube and once the colon is distended with a stimulating liquid the wave of contraction initiated at the ileocecal valve will sweep down the colon and pour the emulsified contents into the descending colon and result in evacuation. With an ordinary enema tip this would necessarily be removed during moving of the bowels and would need to be introduced each time until a sufficient quantity of solution had been used. This instrument does not aim to replace the enema procedure but rather supplements it by making it more convenient to give a series of enemata and in this wise obtain results beyond that which can be obtained with 2 qts. of soap and water. In our sense colonic irrigation is not to be considered as a novel procedure but as an extended enema. For this purpose the apparatus here presented aims to add to the simplicity and convenience of the procedure and to do away with the discomforts and disagreeable features commonly associated with colonic irrigations.



# TELESTEREOROENTGENOGRAPHY\*

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## HISTORY

IN the Odyssey we read: "I have eyes, two eyes . . . and an interior sensation that results from them without anything strange about it." This would tend to make us suppose that the facts regarding binocular vision were rather confusedly known in the time of the Greeks. This rather obscure text, forsooth, should not astonish us, if, as legend has it, Homer was blind.

We must not conclude, however, that the facts regarding binocular vision remained unknown throughout antiquity. Indeed we find very clean-cut notions on this subject in the works of Euclid, the celebrated Greek geometrician, a contemporary of Archimedes, who taught mathematics at Alexandria in Egypt three centuries before our era. His attention had been drawn by the difference in the images in the retina furnished by each of our eyes, just as Porta and d'Augilioni noticed later on. "Seeing in relief," said he, "is receiving by means of each eye the simultaneous impression of two dissimilar images of the same object."

Galen, the great Greek physician, who lived in Rome under Marcus Aurelius in the second century of our era, established the first theory of binocular vision, "The Theory of Identity," based on anatomy and on some observations of hemianopsy.

All these, however, are rather vague conjectures and we have to come down to the end of the 15th century in order to find clearly enunciated the theory of binocular vision. In a manuscript edited at Milan around 1490, Leonardo da Vinci established the difference existing between images of the same object seen by each of the two eyes and the combined image resulting from the superimposition of the two first.

In 1832, Mayo published in "The Outlines of Physiology" a few very definite remarks on binocular vision.

But it was only a few years later, taking as a basis the theories of Mayo, that the English physician Wheatstone thought out an apparatus to show flat pictures in relief. Wheatstone was, as we know, a physician of the first rank, already famous for his measurement of the speed of electricity and by his works on electrical telegraphy. His stereoscope was presented for the first time at the Royal Society of London in June 1838.

Wheatstone's invention was scarcely noticed, and was even completely forgotten when ten years later, Brewster thought out a more practical apparatus by substituting prisms for mirrors, and by placing the two images next to each other.

Despite these improvements, were it not for the discovery of photography, it is probable that stereoscopy would have remained in the domain of the physics laboratories, as did Newton's disk, Mariotte's flask and Madgeburg's hemispheres. The discovery of Niepce and of Daguerre, allowed stereoscopy to soar to its present heights.

It was logical, therefore, because of the powerful interest and the immense development of stereoscopy, to try to utilize its advantages in roentgenography.

The first attempts at roentgenography in relief were made within a few months after Roentgen's discovery, by the Austrian Mach, using two Hittorf tubes. Czermak next conceived the idea of using a single tube and securing the two stereoscopic films by moving the object. Valenta of Vienna, however, it was who first practiced the moving of the roentgen tube.

The first practical results were obtained in France in 1896 by Imbert and Bertin-Sans of Montpellier and reported in a

\* Submitted for publication May 15, 1930.

paper read at the Academy of Sciences, March 30, 1896. Shortly after, on November 29, a radiologist of Lyons, Destot, presented a memoir to the Biological Society concerning "The Application of Stereoscopy to the Study of the Circulatory Apparatus."

In 1897, Levy-Dorn in Berlin published a very important memoir on "The Value of the Stereoradiographic Method from the Surgical Point of View."

At almost the same time Marie and Ribaut of Toulouse published<sup>1</sup> their first article inspired by the work of Cazes, "Precision Stereoscopy," which had appeared shortly before at Pellin's.

Since then numerous radiologists have devoted themselves to this branch of technic and proclaimed its advantages. Since we cannot quote all the names of those who have studied this very important question, we will mention those only of Bécclère, Belot, Aubourg, Ledoux-Lebard and Halluin in France; Henrard in Belgium; James MacKenzie-Davidson in England; Albers-Schoenberg, Haenisch, Groedel, von Gruenmach in Germany; Wenckebach in Vienna; Carl Beck, Lester Leonard, Dunham and especially Case in America, and Pirie and Pariseau in Canada.

#### DEFINITIONS

Before we undertake the study of the technic of stereoroentgenography, a few definitions are indispensable. By the name of stereogram we designate a pair of films destined to reconstruct the plastic image. Every region is represented there from two different angles. The reproductions of the same point on the two films bear the name of homologous points.

The separation of the homologous points on the two films increases first, according to the distance between the location of these points in the region being roentgenographed and the surface of the film; and, secondly, according to the tube shift.

Relief in stereoscopy is especially based on the separation and the exact location

of these homologous points. Therefore, our attention must bear on these. For reasons of physiological optics, the separation between homologous points should remain within certain limits; otherwise the fusion of the two images is impossible.

#### THEORY

The analytical exposition of the theory of stereoscopy has been well studied in the "Physiological Optics" of Helmholtz in the chapter entitled "Rules for Stereoscopic Projection." We cannot undertake here to repeat this study or give exact rules for stereoscopic parallax, since this would exceed the limits of our study which is restricted to stereoroentgenography. Suffice it to say, for geometrical, optical and physical reasons, the separation between the homologous points is subject to laws which must be respected if we wish to obtain good stereograms.

The limit of separation of the homologous points has been determined for an average eye and account has been taken in the diverse formulae given for the calculation of the tube shift between the taking of the two films.

The stereoscopic parallax for any given object can be measured by the algebraic difference of the angles of convergence between the first and last plane.

The stereoscopic parallax increases as the interpupillary separation of the observer increases. (Subjects whose pupils are greatly separated are therefore favored from the point of view of stereoscopy.)

On the other hand, there is an advantage in increasing the base of observation. It was this principle which was applied by the telemetrists, a number of whom in the Navy use a base of 10 m. and it is this same principle which we apply in tele-roentgenography with a wide base. The parallax increases likewise with the thickness of the object under consideration and when the object is nearer, all other constants remain unchanged.

Stereoscopic acuity is a function of the minimal binocular parallax of a subject.

<sup>1</sup> *Arch. Physiol.*

It is a physiological constant just as is visual acuity, and is exercised like the latter at all distances.

The measuring of stereoscopic acuity is carried out for telemetrists and aviation pilots in the optical laboratory of the Army by means of a test. This acuity is developed by exercise and is lacking only in those individuals who are subject to strabismus or a very marked astigmatism.

#### TECHNIC

The technic of stereoroentgenography comprises two parts: first, the exposure of two dissimilar films of one and the same region; second, the fusion of these two films for the reconstruction of the plastic image.

The making of the stereoscopic films will differ, from the technical point of view, according to whether we are considering immobile organs such as bones of the limbs or the spinal column, or the viscera whose movements are more or less independent of the will. For the skeleton, the former technic employed by the early roentgenologists is sufficient.

The focus of the x-ray tube is moved between the exposure of the two films in a direction parallel to one of the edges. The amount of tube shift represented by  $\Delta$  was formerly the object of many controversies. We can satisfy ourselves with moving the x-ray tube, 6, 7 or 8 cm., which movement will give, according to the thickness of the parts, plastic effects which will be either insufficient or too pronounced. At times, even if we are considering an anteroposterior roentgenogram of the cranium taken at 50 or 60 cm. focal distance, it is almost impossible for observers to fuse the two images.

#### FORMULA OF MARIE AND RIBAUT

Certain roentgenologists, however, operate with more exactitude and still apply the formula of Ribaut and Marie for the making of their stereograms.

This formula gives the amount of the tube shift between the two films, taking

account of the thickness called  $p$  of the region studied and the distance called  $D$  that separates the focus of the first plane from this region.

First case  $D=50$  or

$P=10$

$$\frac{50(50 \div 10)}{500} = \frac{50 \times 60}{500} = \frac{30}{5} = 6 \text{ cm. } \Delta$$

Second case  $D=50$  or

$P=20$

$$\frac{50(50 \div 20)}{1000} = \frac{50(70)}{1000} = \frac{35}{10} = 3.5 \text{ cm. } \Delta$$

In a general way the tube shift  $\Delta = \frac{D(D \div P)}{50P}$  increases with  $D$ , the focal distance and decreases when  $P$ , the thickness

of the roentgenographed region increases.

This formula, somewhat lengthy to establish, gives good results for stereograms taken at a short distance.

#### STEREOROENTGENOGRAPHIC APPARATUS

If we are satisfied, at the beginning at least, with doing stereoroentgenography of the skeleton and particularly of the limbs, the equipment can be very limited. All that is necessary is to immobilize the patient well on a table or a Potter-Bucky diaphragm, and to center the tube on the center of the cassette, this point being very important for obtaining good stereograms. This centering having been made very carefully by means of a plumb-line or any other appropriate apparatus, we then move the tube toward the right, in a direction parallel to one of the edges of the cassette for a distance of 31 mm., or half the amount of the total tube shift. Ordinary tube stands are provided with a graduated scale allowing us to carry out this shift without angulating the x-rays.

Under these conditions the impression of relief sufficient for stereograms of the limbs does not allow distinctly the perfect dissociation of the planes and the reconstruction of the plastic image of the pulmonary parenchyma, for example.

## THE CONVERGENT METHOD

From the works of numerous authors and from those of Quidor undertaken around 1909 at the Sorbonne in the Laboratory of Professor Delage, it has been ascertained that the notions of distance and relief become more exact when we converge the optical system of the visual apparatus or of any other stereoscopic apparatus.

The study of the angulation of the optical system in photographic apparatus, in binoculars and in binocular microscopes with single objectives, shows the superiority of the convergent method over the parallel method previously described. The works of Quidor reported in his Doctor of Sciences' Thesis, leave no doubt as to the superiority of the convergent method.

"Two methods," says he, "the parallel and the convergent deserve our attention, for each one springs from a different principle." There is also the problem of stereoscopy.

The convergent method is less inclined to force the observer to reconstruct geometrically the space represented than to force him to repeat before the stereoscope the efforts of convergence which direct observation of this space would demand. It is, therefore, more exact than the parallel method, according to Quidor.

The method of rotations has shown, on the other hand, that the sensations of relief were not due exclusively to phenomena of convergence, and that another factor, the inequality of the retinal images of the object observed, played an important rôle in these phenomena.

It is proper, besides, to remember that in the convergent method this inequality of images impresses on the parallax variations which would contribute to render this method more sensitive than the parallel method even if the phenomena of convergence were the only factors of relief. Relief is due then exclusively to the convergence of the visual lines, to the inequality of the retinal images, or

to a synthetic action of these two factors. The superiority of the convergent method as compared to the parallel method is completely established; and notions of relief and of distance become more exact. The practical application of this convergent method has been realized in microstereography, in the microscope constructed by Nacet along the lines indicated by Quidor. This apparatus differs from the ordinary model by the angulation which the tube of the microscope can undergo to the left and to the right of the vertical with regard to the plate. This angulation is measured by a graduated drum.

The dark chamber is placed above the microscope and allows the taking of two views of the same object one after the other at two different angles, as with American apparatus; the dental stereographic apparatus of Ritter likewise uses the convergent method, just as all American apparatus does, and the Gaiffe-Gallot-Pilon apparatus has been constructed along these lines.

## ANGULATIONS

It is our opinion that the stereoscopic effect is greatly improved and the film more defined when we use the convergent method, for we can in addition, use the diaphragm to the utmost advantage.

With old models and tube stands, the convergent method is not practicable, for the focus, as I said before, should always remain at the same distance from the cassette during the time of changing. In America, on the contrary, where stereoroentgenography is employed systematically, tube stands are provided with a special apparatus allowing the exact angulation of the tube by a direct reading of the graduated scale. This angle measures about  $15^{\circ}$  in ordinary stereography and the variations are still more important with modern methods.

## CRITICISM OF THE OLD CLASSICAL METHOD

In a general way, this calculation, this

minute centering, this perfect immobilization, this tube shift and this angulation, render the method long and difficult. In hospital service, the making of a stereogram under these conditions monopolizes the roentgenographic table and interferes with the service for a half hour, or even an hour at times, because the films often have to be retaken. On the other hand, the inconsistent results due to errors in calculation, to movement on the part of the patient or to the locks immobilizing the tube in its two extreme positions, the difficulty of placing the second cassette exactly in the same position as the first, all of these have a tendency to make us use stereography as little as possible.

Realizing these shortcomings (loss of time and often mediocre results) we sought for more than ten years to perfect this method which was still primitive in spite of the advances of roentgenography. First of all, upon studying closely the results obtained by the best German and American roentgenologists, we realized that the failures, especially for the larger cavities and the thorax in particular, depended on the fact that the pair of stereoscopic films were taken at too short a distance and that the outstanding principle formulated by Druner, that the stereogram should be taken at a focal distance of at least four times the thickness of the part in question, was not always observed.

#### ADVANTAGES OF TELEROENTGENOGRAPHY

We can imagine then, without any trouble, that a thorax of 25 cm. thickness, stereographed at a focal distance of less than a meter gives a defective plastic result. Therefore in France, we tried to use the teleroentgenography which had been well studied in Germany by Albers-Schoenberg, Groedel and Alban Koehler, and in France by Delherm and Laquerrière, and in particular by a number of American and Canadian roentgenologists. This method presented, in addition, the advantage of giving more definite and undis-

torted images whose superimposition was effected more easily. Finally, as the climax of this method on the value of which Dr. A. Béclère insisted most particularly, the practical absence of distortion and magnification of the parts most distant from the film allowed the anteroposterior or posteroanterior stereoroentgenographic study of a region which is indispensable to confirm or deny a previous examination.

By using at the beginning American Victor and Kelly-Koett rectifying switches with a Wappler timer, then French Gaiffe-Gallot-Pilon apparatus able to produce 300 to 400 ma. at 150 kv., with a Gaiffe relay timer, we were able to produce routinely good teleroentgenograms between 1 m. 10 and 2 m. 50, this Gaiffe relay timer making it possible to expose films always with the same quantity of x-ray radiation with constant results.

From a methodical study pursued for more than three years including the exposure of more than 15,000 films, we ascertained experimentally that in order to save the tubes and to give them the greatest life possible, it was preferable not to use them at several hundred milliamperes with 50 or 60 kv. peak, but, on the contrary, with a milliamperage of 70 to 100 under tensions between 100 and 125 kv. peak. At the present time, we are working at about 118 kv. peak maximum.

Then, since the work carried out under these conditions excited the radiations K of the tungsten target and the intensifying screens, we obtained at these tensions a maximum photographic effect by reducing considerably the time of the exposure and the number of kilowatts received by the anode. Finally, this method has two prime advantages: the economy of tube life and the rapidity of the exposures.

Under these conditions, the making of teleroentgenograms is possible with all modern installations; and at the present time all rectifying switches and kenotron apparatus permit the use of at least 70 ma. at 120 kv. peak, which is sufficiently rapid to obtain good teleroentgenograms.

## HYPERSTEREOGRAPHY

Upon examining our two teleroentgenograms made with an ordinary tube-shift base we found out that the plastic effect was clearly insufficient and that a thorax, for example, appeared almost flat since the separation of the homologous points was too small.

Thus it occurred to us to apply to roentgenography for the first time the principles of superstereoscopy which had already given marvelous results in microphotography, in aerial photography and astronomy.

## HYPERSTEREO-ROENTGENOGRAPHY

It was logical, therefore, to try to utilize in roentgenology that new science so promising for the future, which, according to Appel, is the equivalent of a true sixth sense. Properly speaking, we are concerned here with a real process of enlargement of our perception of the relief analogous to the enlargement produced by the microscope. It is sufficient to increase the separation of the homologous points by increasing the value of the tube shift  $\Delta$  while it is within the physiological limits and by preserving the similitude of the forms. We can thus best dissociate the several anatomical planes.

The amount of the tube shift can be very easily calculated by the formula which we enunciated several years ago.<sup>1</sup> This formula, which we have established on advice of Dr. A. B  l  re, is based on the diverse theories and laws of stereoscopy and of hyperstereoscopy and also takes account of the physiological factors. Moreover, it has been used experimentally thousands of times over a period of a number of years.

## AUTHOR'S FORMULA

$\Delta$  tube shift equals  $P$  which is the thickness of the part when  $DF = 8P$  or a thorax of 20 cm.

Maximum tube shift equals 20 cm.

<sup>1</sup> *J. de Radiol. et d'Electrol.*

when  $DF = 1$  m. 60. After long personal experimenting the author was able to ascertain the amount of tube shift giving the best results.

In order to avoid figuring for roentgenologists who are short of time, I established a number of formulae which appeared two years ago.<sup>1</sup> These formulae gave, by direct reading and without figuring, the amount of tube shift. When the focal distance is given, it suffices to take the thickness of the part to be roentgenographed with the aid of a thickness gauge or caliper like those we had made by Gaiffe-Callot-Pilon or take one-tenth of the focal distance for the thorax and the abdomen.

## AUTHOR'S TELEOSTEREOROENTGENOGRAPHIC APPARATUS (GAIFFE-CALLOT-PILON)

One must make the exposure of the films rapidly; just as those who specialized in visceral stercoroentgenography in a serious way were able to ascertain, it is indispensable in order to obtain a correct plastic effect to take the two films comprising the stereoscopic pair in just as short a time as possible.

Indeed, in taking the two views rapidly we must be careful not to displace the homologous points; otherwise they will produce a false stereoscopic effect. This extremely annoying phenomenon which cannot be avoided takes place likewise in stercophotography when the two views are taken at a long enough interval.

In the first attempts made at Hamburg in 1906 at the Clinic of St. George by Albers-Schoenberg and Hachisch, the large intestine sometimes appeared in the vertebral column because of the segmentary contraction of the colon between the taking of the two views. The same is all the more true for the stomach, the duodenum and the lungs, when in a number of cases, a displaced clavicle or rib or a diaphragm has displaced the homologous points. We were unable to avoid this dangerous annoyance as long as we had at

<sup>1</sup> *J. de Radiol. et d'Electrol.*, 12: 305, 1928.



our disposition only semi-automatic stereoscopic apparatus or apparatus worked by hand.

kv. peak. Hence the necessity of employing tensions greater than that if we wish to obtain high speed results.

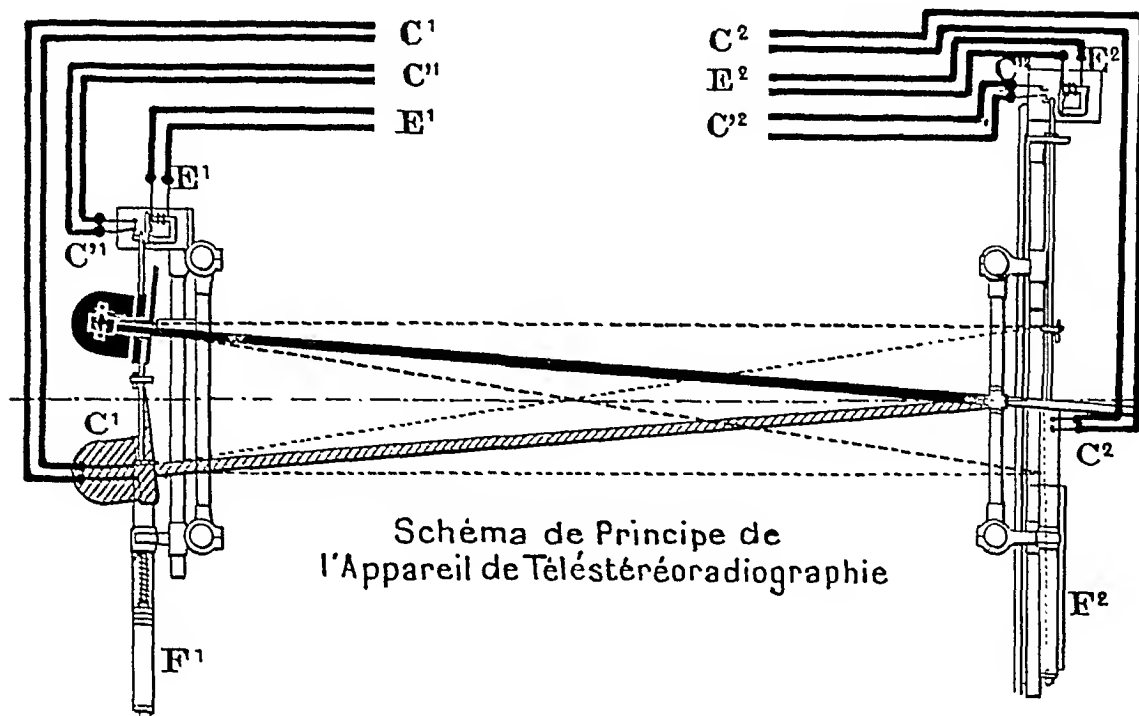


FIG. 1.

#### CHARACTERISTICS OF A STEREOGRAPHIC APPARATUS

The essential characteristics for obtaining an ideal apparatus can be summarized as follows:

First, elimination of all jar and the least vibrations in the changing of position of the cassettes.

Secondly, the possibility of making stereograms in the six vertical classical positions, in all sitting and recumbent positions.

Third, the speed not exceeding one second for the exposure of the two films comprising the stereoscopic pair and the sum total of the movements in changing the two cassettes and the tube.

Fourth, safety. We recognize the necessity of working at tensions of the range of 100 kv. peak if we wish to obtain clean-cut instantaneous films at a correct focal distance by exciting the ray K of tungsten, by an x-ray radiation that contains a sufficient quantity of wave lengths of .178 of an Angstrom unit. The ray K is excited with sufficient intensity beginning only with 90

Fifth, simplicity of operation reduced to the simple pressure of an electric button during a fraction of a second only.

Sixth, the realization of an apparatus practical for both operator and patient.

Seventh, extreme rigidity of all parts of the apparatus in view of its automaticity and the rapidity of movements from which are derived permanence and absolute constancy of results, 100 per cent good stereograms.

Eighth, adaptation to technics preferred by each individual roentgenologist. Possibilities of varying the focal distances between 1 and 2½ m. and anode separations between 2 and 40 cm.

The old apparatus would not allow the taking of stereograms in less time than one and one-half to three seconds; thus they were mostly too slow for practical results. Indeed, because of the moving of the homologous points between the two views, these localizations were often false and a tumor, an abscess or a calculous shadow which was in front appeared to be behind. The diaphragm, as Dr. Leo Pariseau



observed in 1925, appeared to be outside of the thorax at times. We can then imagine, without difficulty, the danger

radiation to a minimum and obtains good contrasts in spite of using tensions higher than 100 kilovolts peak (Fig. 2).

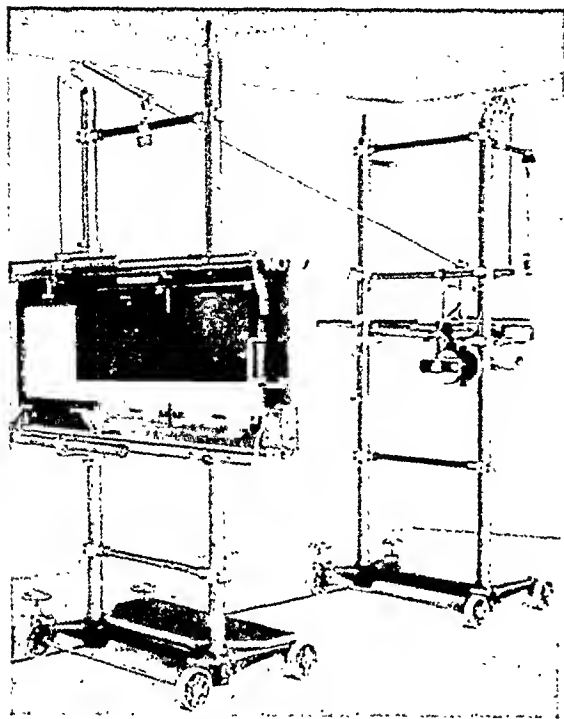


FIG. 2.

that a patient might undergo in having pathology localized in an indefinite way.

For this important reason, we have tried to increase the speed and to have a teleostereoroentgenographic apparatus constructed by Gaiffe-Gallot-Pilon that would be entirely automatic and would allow the making of a stereogram in a fraction of a second (Fig. 1).

This apparatus is composed of two metallic frames placed vertically and parallel to each other, whose separation allows the exposure of films at distances varying between 1 m. and  $2\frac{1}{2}$  m. One of these frames constitutes the tube support. The latter can shift from zero to 40 cm., thus allowing teleoroentgenography with a shift of 6 cm., an application of the formula of Marie or of Diocles and the using of the hyperstereoscopic basis indicated in our formula. A set of special diaphragms square, rectangular, circular, oval and in the shape of a Roman window allows the reduction of the secondary

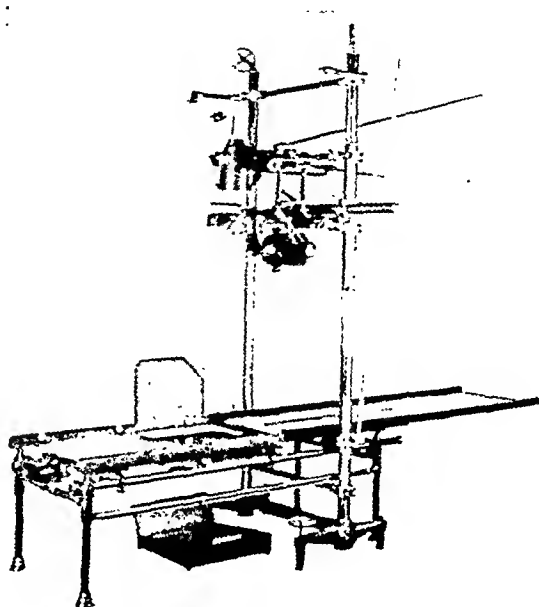


FIG. 3.

Recently, at the request of Dr. Surmont, Professor of Clinical Medicine at Lille, the author's model has been amplified making it possible to make roentgenograms in a horizontal position. The tube support was simply provided with a new piece which allowed the fixing of the tube in the horizontal position (Fig. 3).

As for the cassette tunnel, it is fixed above a table mounted between the columns of the tube stand. This table possesses a non-opaque top movable longitudinally on ball-bearings so as to easily center the normal ray over the desired region. The fluorescent screen turned towards the floor is seen by reflection in a mirror inclined above it. The focal-film distance may vary between 75 cm. and 1 m. 60. The second framework supports the cassette tunnel and radioscopic screen. The two cassettes are mounted in an apparatus with hinges allowing the rapid substitution of the cassette for the screen. These two frameworks are united mechanically by an extensible rod on a pivot and moving on a joint having a vertical axis of rotation from the tube head in such a

way that the point of incidence of the normal ray is always perfectly centered, no matter what the tube shift and the focal distance employed. All the theoretical conditions are therefore observed in a practical way to obtain the maximum plastic effect.

These movements of the tube and of the two cassettes take place automatically by means of a series of electromagnets and pneumatic brakes which work by friction and slow down toward the end of the course.

Since the operation is electrical, it is very simple. One simply presses an electric button for a fraction of a second in order to get automatic action as follows: the making of the first exposure, simultaneous movement of the tube and the cassettes and the making of the second film exposure. These operations are carried out in less than a second, thus making this apparatus the most rapid of all.

Thanks to a universal arrangement it will be possible henceforth to practice hyperstereoroentgenography of the most movable visceral organs (Fig. 4). The vertical position is preferred for a study of the lungs, the heart, the aorta, the mediastinum and the stomach. For the cranium, sinuses of the face and the mastoids, as also for the cervical column and the upper limbs, the vertical apparatus is likewise sufficient.

The horizontal arrangement is indicated for the study of the duodenum which is particularly advisable in the prone vertical right position, as has been demonstrated by Cole, George and Case in America, Ledoux-Lebard in France and Chaoul in Germany.

The small intestines and especially the pelvic colon and the appendix will be shown better in the horizontal position. This latter arrangement will be especially useful for the making of stereograms of the dorsolumbar spine, the pelvis, and in cases of pregnancy when the exact position of the fetus is to be determined. The horizontal arrangement must equally be used in preference for the lower limbs.

These two arrangements complement each other, therefore, and in combination they make possible, without loss of time,

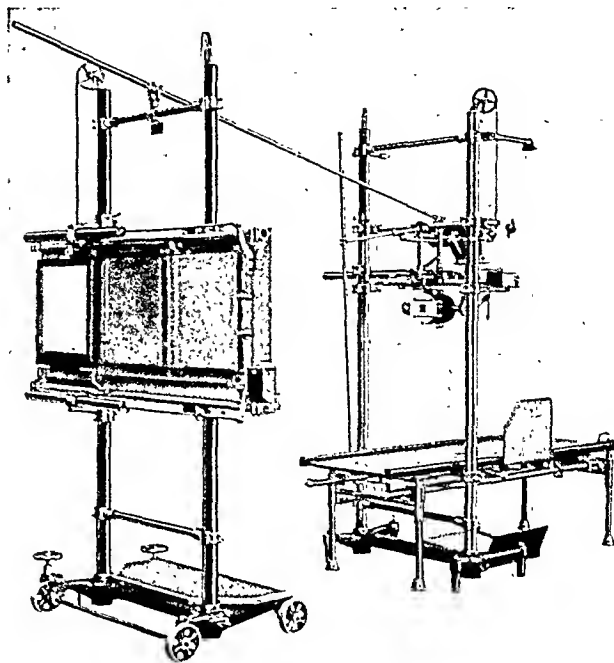


FIG. 4.

the making of stereograms of all parts of the skeleton and of the viscera.

I recently went to Berlin and saw how an apparatus, because of its fragility, vibrated during the taking of the second film and had to be taken off the market. The big firm of Siemens recently built an apparatus for teleroentgenography based on the principles of telestereoroentgenogram and hyperstereoroentgenography which I have discussed.

This apparatus comprises two tubes. The changing of the films is done by an electric motor which rolls up the film between the two exposures.

#### SIEMENS-REINIGER-VEIFA APPARATUS

This apparatus has three important drawbacks:

1. It requires a rather long time before the filament of the second tube emits a sufficient number of electrons to permit roentgenography of high intensity.
2. On the other hand, the electric motor provided to roll the film imparts a vibration which is prejudicial to clear detail in the films.

3. Finally, two intensifying screens have to apply themselves exactly over the whole surface of the film at the very moment of the x-ray exposure, and this condition is far from being realized in practice. In practice, it has likewise been noticed that the tube shift of 8 cm. provided in the first place was insufficient; and, in these new models, the tube shift can reach 12 cm.

#### BRAUER APPARATUS

The firm of Brauer at Frankfort-on-the-Main is likewise undertaking the production of a rapid automatic apparatus for stereoroentgenography based on the same principles. I saw this apparatus function at Chaoul's in the service of Sauerbruch at the Charity Hospital in Berlin. This apparatus, of which the second model has appeared, does not yet give me complete satisfaction. First of all, it is impossible to center the tube during the fluoroscopy previous to roentgenographing the part under observation. This condition, which we ascertain from the advice of Dr. A. Béclère, is of prime importance if we want to get the maximum of results in stereography. Secondly in this apparatus, the tube shift is limited to 16 cm. Thirdly on the other hand, the perpendicular shift adopted demands several preliminary mechanical adjustments which are impractical within the desirable limits of technic for the exposure of films of the stomach, the duodenum and the large intestine. Moreover, in spite of the appearance of this new German apparatus, some roentgenologists in Germany employ French apparatus in their institutes and hospitals. In the latest and most modern hospital in Berlin, that of Neukoelln, the author's apparatus functions with the apparatus of Koch, Sterzel and Dresde, with six kenotrons connected according to the method of Graetz, able to deliver 2,000 ma. at the poles of the tube.

For purposes of record only, mention will be made of American apparatus with which the reader may be acquainted, but which presents the important defect of

not permitting one to center fluoroscopically and bringing the pathology into observation before the exposure of the films. I will not describe in detail the technic of the making of the films. Those who are interested in this question may be able to come to the laboratories of the hospital of the Hôtel Dieu of Jeanne d'Arc, where every morning between ten and eleven, they will see the making of stereograms according to all the methods that I have pointed out. For purposes of observation, however, the following remarks may be useful. The making of telcstereograms of the cranium and the sinuses of the face should be made at 1 m. 10 at about 100 kv. peak and 25 to 50 ma. in the tube, the quantity of electricity varying according to the incidence,—around 100 to 200 ma.-seconds for the profile. In these cases, an average intensity of 25 to 50 ma. is sufficient and the amount of tube shift averages 12 cm. for the profile, 10 cm. for the face, 8 cm. for the base.

Pulmonary work for tele- and stereograms should be carried out at 1 m. 60 average. The average intensity in the tube should be above 50 ma. to obtain sufficient clearness. A tension of 118 kv. peak, 5 ma.-seconds, will be sufficient to obtain a definite and contrasted film. The amount of tube shift according to our formula will be 20 cm. average and may vary according to the thickness of the patients between 16 and 24 cm.

For teleroentgenogram and stereoroentgenograms of the heart, the focal distance that gives the least amount of deformity is 2 m. 50. The intensity of the current ought to be brought up to between 70 and 100 ma. Under 125 kv. peak, the duration of the exposure can be reduced to 7 ma.-seconds on the average. The amount of tube shift can then be brought to an average of 30 cm. to obtain a plastic effect allowing a perfect dissociation of the several anatomical planes.

The whole skeleton of the limbs will give a good relief at 1 m. 10 focal distance. For stereograms of the hand and the fingers, a

tube shift of 24 cm., those of the wrist, the elbow and the tibiotarsal 20 cm., those of the knee and the shoulder 16 cm.

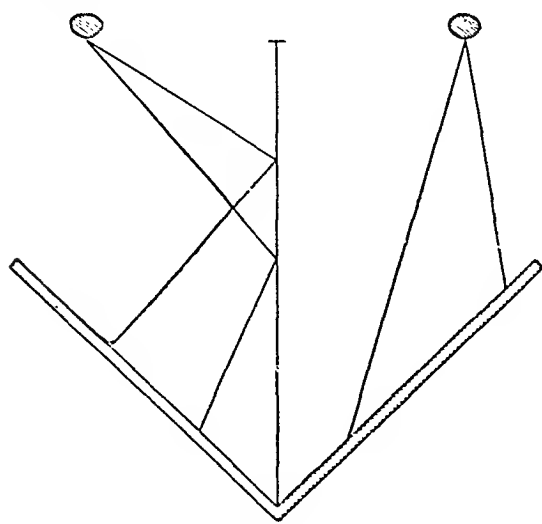


FIG. 5.

#### EXAMINATION OF STEREOGRAMS

That it is not sufficient to obtain perfect stereograms presenting all the desirable conditions of fineness, contrast and definition, one must learn in addition, to examine them correctly.

In the first place the films made when the tube is to the right of the center should be examined with the right eye and those made when the tube is to the left should be examined with the left eye. If we do not do this we get the effect of an inverse relief which is pseudostereoscopic, and with mirror stereoscopes we might be led into error by placing a lesion to the right which might actually be located to the left.

In our apparatus this error is avoided by the marking of the cassettes with a metallic letter.

1. DIRECT EXAMINATION OF LARGE FILMS. This examination is carried out with the aid of two types of stereoscopes, mirror stereoscopes and prism stereoscopes.

First, mirror stereoscopes differ according to the number of mirrors.

(a) The type with a single mirror of the Pigeon type, of which a model is made by Gaiffe-Gallot-Pilon, through the courtesy of Professor Hirtz, is good for small sized stereograms up to 24 × 30 cm. (Fig. 5). It is composed of two negatoscopes joined like the leaves of a book. A central mirror movable around a vertical axis allows an

orthoscopic or pseudoscopic view according to its orientation (the direction of the rays).

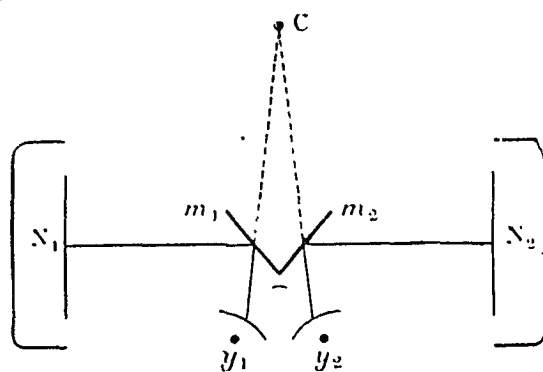


FIG. 6.

(b) The two-mirror stereoscope of the Wheatstone (Fig. 6) type, models thoroughly well made by Victor, Wappler, Gaiffe, etc., is composed of two negatoscopes on which the films are placed, care being taken to reverse them because of the reflection of the mirrors. At the optical center of the apparatus is placed a double set of metallic mirrors allowing the fusion of the images and their reconstitution. Each mirror constitutes an independent optical system and forms an angle with a variable opening regulated by a micrometric screw. A second screw governs the inclination of the optical system around a horizontal axis. Two observers can easily study a stereogram.

This stereoscope, therefore, is the best fitted for hospitals, clinics, and particularly central roentgen laboratories both because of its excellent optical result as well as for the facility it allows of double observation. In America and in England, all the hospital roentgen departments possess a Wheatstone stereoscope.

(c) A stereoscope with four mirrors of the Helmholtz type, of which Siemens built a good model, is especially used in Germany. Its optical result is hardly inferior to the Wheatstone stereoscope, but it is a less cumbersome apparatus.

#### PRISM STEREOSCOPES

The large sized stereograms can likewise be studied directly by placing them alongside each other in a large negatoscope. The excellent model of Dr. Belot

is perfectly convenient for small sized films up to  $24 \times 30$  cm. For the large sizes,  $30 \times 40$  cm. and  $36 \times 43$  cm., it is neces-

is somewhat delicate because of two adjustments of the eye pieces and the movement of the objectives.

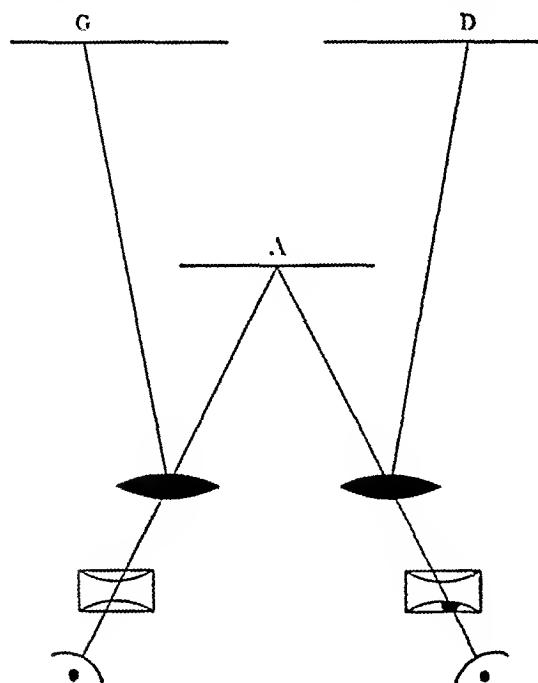


FIG. 7.

sary to use two pairs of negatoscopes. The type built by Kolen is especially convenient, thanks to the intermediary set which facilitates the centering and the fusion of homologous points. Observation can, therefore, be carried out with the aid of binoculars of different types. First, the stereotelescope of Matthey, the oldest in time, was built primarily for the observation of stereoscopic projections. The conditions under which the examination is carried out are good for stereoröntgenographic films of large size. This apparatus is composed of two biconvex lenses with variable separation to which have been added two biconcave lenses which function as the eye piece and serve for enlarging and drawing images nearer. It is therefore a combination of the stereoscope and of Galileo's telescope (Fig. 7).

The biconcave lenses which constitute the objectives are not placed in the same optical axis as the eye pieces. Their separation is greater so that the biconvex lenses work like prisms and become images each in the opposite sense. The regulation

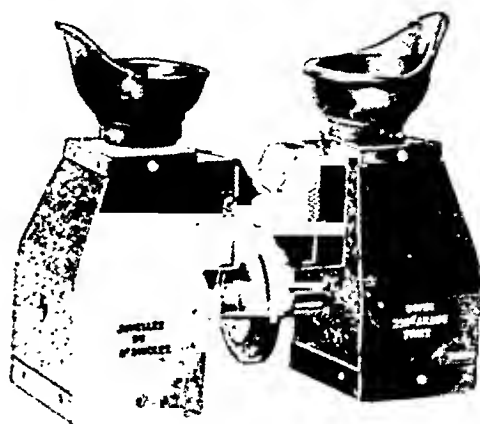


FIG. 8.

It is likewise necessary to keep the apparatus exactly horizontal. The plastic effect is well realized and the image is seen, not reversed, twice as big as normally; but one must examine the films at a distance greater than three times the height, or 1 m. 30 minimum for a film size of  $36 \times 43$  cm.

Secondly, orthoscopic, and pseudoscopic stereoscopes have been made by Richard according to the directions of Colardeau, Professor of Physics at the Lycée Rollin. In the orthoscope the eye piece consists of a prism of  $10^\circ$  and in the pseudoscope a prism of  $3^\circ$ . In these two apparatus, a system of joined diaphragms allows the separation or the bringing together of the openings symmetrically in relation to their axis.

By standing at about 1 m. 30 for the size of  $36 \times 43$  cm., one gets a good plastic effect; and one can study the films without displacing them, both anteroposterior and posteroanterior.

#### PRISM BINOCULARS

These are binoculars of the shape and appearance of opera glasses (Fig. 8). They consist essentially of two prisms whose bases are turned towards the axis of the apparatus.

The eye pieces consist ordinarily of flat pieces of glass or of biconvex pieces of glass dioptrics in certain particular cases when

it is necessary to study a film in greater detail. The regulation is done very simply by means of a single knurled screw placed in the middle of the apparatus. Examination of large films is carried out at less than 1 m. which allows one to place the two negatoscopes before one on a desk, for example, to study the films, holding the binocular in the left hand whilst making notes with the right. It is very possible to center the binocular over the various parts of the films.

It is our opinion that this is the best apparatus for the radiologist or the practitioner for it allows a very rapid examination of stereoscopic films without fatigue. Its low price and small size and its lightness will popularize its use since it can be easily carried from laboratory to laboratory. It is doubtless the stereoscope of the future.

11. A STUDY OF REDUCTIONS. The examination of stereoscopic reductions is carried out in different ways; first, with the aid of a hand stereoscope of the Brewster type, of which there are numerous models (Mattey built more than 400 of them). These stereoscopes are simple, practical and widespread in use because of the wide diffusion of photographic stereoscopy which has a tendency to supplant flat photography more and more.

The optical system of Brewster's stereoscope consists of two prisms with convex surfaces drawn from two thick lenses, 18 cm. focal distance, and whose base rests on the lateral parts of the instrument. The reductions are placed in a groove behind which there is a frosted glass. A vertical board allows either eye to see only the view which it is supposed to see. The focusing is done by varying the distances that separate the reducing prisms.

This stereoscope, of the so-called Mexican type, is very low priced, and can be recommended to patients and doctors for the study of small stereoscopic films. There are also other stereoscopes in which the prisms have been replaced by lenses and which have a focusing device for the eye pieces, the variations of which can be made with very great exactitude. This

apparatus consists of a box opaque to the rays of light and is devised to eliminate parasitic images and outside light absolutely.

These stereoscopes are therefore more exact and have a better plastic effect than the preceding apparatus. They are, therefore, serviceable for hospitals and doctors who do not possess large stereoscopes and who desire to study with exactitude the stereoscopic reductions of the roentgenograms of their patients.

#### A DIRECT EXAMINATION OF THE REDUCTIONS WITHOUT A STEREOSCOPE

But the best stereoscope and the simplest is our own visual apparatus, for with both eyes we habitually perceive the relief of objects and very little training suffices in order to perceive in relief two stereoscopic images. A slight muscular effort analogous to a trial strabismus allows the convergence of the optical axes and the perception of the relief.

At the beginning, it is good to practice with the aid of a piece of cardboard 40 cm. long so that each eye can see only the element which is destined for it. You can see the two images approach progressively and then fuse together; it is sufficient to keep a film exactly horizontal in order to keep homologous points at the same height. That is the way we study our stereoscopic reductions. It is the quickest and best procedure.

At the present time, we can classify the methods proposed up to now for getting good stereoscopic projections into two classes: first, projections with superimposed images where the two images respectively destined for the right and the left eye are projected together on the screen in such a way that each of them comprises the whole of the surface of the screen. Thus, the two images cover each other. Since they are not identical, they cannot superimpose themselves in their entire outline; hence a confused contraction results from their coexistence. Whence the final result will be extracted only as each eye sees but the one image

destined for it. This selection of images can be obtained in three different ways.

(a) By the eclipsing apparatus designed by Mrs. Charles Dupuis and W. Schmidt, D.P. This apparatus is based on the well-known property of the persistence of luminous impressions on the retina. The two images projected on the screen are only lighted up at very close intervals by means of a rotator turning at high speed. Before each observer a second screen animated by movement strictly synchronous with the first, allows each eye to select the image destined for it. This apparatus gives a very beautiful relief with alternations of 30 or 40 per second and if we get a very high stability of the images without a disagreeable jarring produced by certain projectors, this process seems to us especially favored for cinematographic projections in relief.

(b) Apparatus with networks whose principle was studied out by Estanave are very interesting from the theoretical point of view but do not give practical results since the observers have to occupy a very definite position varying within very narrow limits.

(c) Apparatus with continuous illumination. The selection is obtained by the procedure of anaglyphs of which we have already spoken.

#### PROJECTION WITH A SPECIAL LANTERN

There is on the market a whole line of small lanterns which enable the obtaining of projections in relief. By this procedure before a small audience, the firm of Georges Richard and the firm of Gaumont built models which allow projection of the use of  $4\frac{1}{2} \times 6$  cm. and  $6 \times 13$  cm. under good conditions. Matthey has just built a model particularly interesting for radiologists which allows the projection of all the stereoscopic sizes from  $4\frac{1}{2} \times 6$  cm. to  $8\frac{1}{2} \times 17$  cm. This apparatus, which I was able to examine, works better on our regular electric lighting circuits. The best lantern at the present time for projecting anaglyphs in a vast amphitheater is, in our opinion, the one produced by Gaumont

according to specifications of Gimpel and Touchet. The principle is based on the procedure of Almeida and two complementary color screens are interposed in the path of luminous rays. They allow the projection of two elements of the stereoscopic pair in two colors, one green and the other red. Mr. L. Gimpel has shown by his very interesting work that he was not indifferent to choosing such a pair which are complementary to each other and that one was to take account of the physiological effect of the colors on the retina. The best result is furnished by blue-green and red-orange screens whose preparations are made with the aid of a mixture of Hoechst and Tartrezine and carmine-blue for the first and a mixture of cosin and Tartrezine for the second.

The projection is examined with the aid of selective binoculars in such a way that each eye can see only the element destined for it.

The luminous source must be very intense because of the absorption of the screens in a room of large dimensions. It is necessary to have at one's disposition an arc of 40 amp. This point, which should be emphasized, is of very great importance and should draw the attention of doctors who desire to do stereoscopic projections. Indeed, after having used the same apparatus, the same operator and the same views at two meetings, one on Seine Street at the Medical Society of the Hospitals and the other in the Amphitheatre of the Hôtel Dieu in Paris, I found the quality of the projection to be infinitely superior in the latter hall. The variation depended principally on the different electrical energy available.

The arc of the lantern is placed in the center of a large special condenser composed of four lenses of which two are placed so as to receive the bundle of essentially parallel x-rays and divides them into bundles which are gathered up by each one of the objectives.

The stereoroentgenographic reduction of the size  $8 \times 16$ ,  $8 \times 13$  or  $45 \times 107$  cm. is placed in a frame which allows the rays to



pass behind the colored glass. There is, therefore, no modification or coloration intended for it and the view can serve as we have already said, for two purposes: a direct examination with the stereoscope and with projection, which is a valuable double advantage. The objectives of the lantern present arrangements which allow the superimposition of images in the rear planes. The body of the chamber possesses a backward and forward movement which allows the utilization of objectives whose focal distance vary between 150 and 400 mm.

This manner of projection, which utilizes ordinary stereograms on glass, constitutes one of the best procedures for every possessor of a collection of stereoscopic apparatus.

*The Projection of Views in Relief with the Ordinary Projection Lantern.* For those who do not belong to this category, there exists another method which has the advantage of not requiring the use of the special lantern. It consists in preparing pigmented anaglyphs in which the two perspectives previously printed in orange-red and greenish blue will be superimposed on every film and can thus be examined either individually or in a projection with any lantern, on condition, of course, that we use the selective binoculars.

This means presents another advantage, that of being able to utilize a dimension greater than the small stereoscopic form imposed by the medial separation of the eyes and of allowing one to discover more details in an image reduced only to a size of  $8\frac{1}{2} \times 10$  or better still,  $9 \times 12$  cm.

Up to very recently, the preparation of images in colors was complicated and uncertain. Let us recall briefly the long and costly pinatype procedure of the fixing of silver images of Dr. Traube and of Abbé Tanleigne, whose first applications to roentgenography are due to Dr. d'Haluin. This method necessitated twelve different operations, at the end of which it was impossible to bring the least correction of a defective correlation. At the Third Congress of Industrial Chemistry, Mr.

Seyewetz presented a very complete study of the diverse procedures allowing the transformation of the silver photographic image into a fixer capable of fixing certain colors properly.<sup>1</sup>

From this study, it was evident that the sulphur cyanide of silver process which was prepared by the Lumière Company under the name of "panchromogenous developing" was the one that gave the best result. Its use is very simple since it requires only two baths or four operations with the washings. It offers, moreover, the very appreciable advantage of being susceptible to corrections when the tint obtained presents any defect. Mr. Leon Gimpel used this method of fixing for the preparation of anaglyphs which he presented to the French Photographic Society on June 28, 1929. The colors used are composed of a mixture of a certain proportion of yellow to red and to blue in such a way as to obtain an orange red and a greenish blue complementary to each other.

It is a question of choosing from the existing procedures the one that best answers the needs of the projection of stereoroentgenograms: firstly, if one can take roentgenoscopic monochromes by reduction, and this is perfectly possible, apply the procedure of Ducos Du Hauron; one will need a lantern of only average luminous power and glasses of tinted gelatine. Secondly, if one can use only reductions in black, since light is never lacking now, the procedure of Almeida, which is the most simple, and the lanterns of Gaumont and of Matthey are indispensable. The author prefers the apedioscope of Bellieni in its present form, given it by Massiot, and this for two reasons: One can project the stereoscopic pair directly from the normal from  $8\frac{1}{2} \times 17$ ,  $8 \times 16$ ,  $6 \times 17$ , or  $45 \times 107$  mm., such as it exists for direct vision and without uncoupling it. We use a single lantern provided its condenser has a sufficient diameter. This same lantern eventually lends itself for projecting ordinary roentgenograms.

<sup>1</sup> See *Bull. French Photographic Soc.*, September, 1925.



OBSERVATIONS ON  
THE PATHOLOGY OF SURGICAL TUBERCULOSIS  
WITH PARTICULAR REFERENCE TO THE INCIDENCE OF  
TUBERCULOUS BACILLURIA\*

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IN a disease so chronic as tuberculosis, so insidious in its onset, so obscure in its early manifestations and so slow in its progress, there are many pathological problems which are difficult of elucidation. One of the most interesting and important of these problems is that which deals with the spread of the disease, its entry into the body and its dissemination to distant parts from the primary focus. In patients with bone tuberculosis, this is a subject of importance, though unfortunately it has been nearly completely overlooked. Some details of the present state of our knowledge in this matter may therefore be of value. For too long a time has it been customary to regard tuberculous lesions of bone as isolated examples of the disease. Tuberculosis of the hip, for example, has been looked upon as tuberculosis of the hip and nothing more. In reality it is but the local manifestation of a more or less generalized disease. To treat the disease of the hip alone is to treat the patient inadequately. We must have some knowledge of the place the diseased hip occupies in the pathological chain before we can plan treatment properly.

The sequence of events which leads to the establishment of bone tuberculosis can best be studied in children. In them the disease is of relatively short duration. It is obvious that when tuberculosis of the hip is found in a five-year old child the whole course of the disease from the first contact with tubercle bacilli to the production of the bone lesion must have taken place within that five years and probably within a considerably shorter period of time. It is not a matter of great difficulty to scrutinize the whole period of the child's

life and the whole of its surroundings in an attempt to find the source from which its infection arose. This is the more easy since the early years of life are spent in contact with a limited number of individuals. For practical purposes the only contacts with the world have been with members of the immediate family. The number of potential sources of infection is limited and search for the source is easy and successful in a high percentage of cases. In adults the search for the source of the primary infection is more difficult. The onset of the infection from which they suffer in adult life may have occurred so many years previously that search for its origin is hopeless. In adults too the progress of the disease is not the simple picture seen in children. The latter are meeting tubercle for the first time. Their defense mechanism is of a relatively simple type. The disease, if it progresses, marches from organ to organ in a manner which can be followed with relative ease. In adults we frequently, indeed usually, have to deal with fresh infections implanted in individuals who already have a high resistance against the disease. Exacerbations of old foci, and elaborate defense mechanisms which tend to localize the disease in the area of primary invasion, render the picture complex. The pulmonary lesion of adults, for instance, is entirely different from that of children. What follows, therefore, is based chiefly upon knowledge gained in the study of tuberculosis of bone in children.

Children become infected with tubercle bacilli from one of two sources: from human beings with open pulmonary tuberculosis and from the infected milk of tuberculous cattle. As far as I have been able to deter-

\* Read before Section of Orthopaedic Surgery, New York Academy of Medicine, March 21, 1930.<sup>1</sup>

mine, from personal observation, neither form of organism has a special predilection for bones. The incidence of either form of infection in bone lesions varies with the incidence of the two forms of infection in the children of any community. There is no special association between bovine organisms and bone lesions. Organisms from both sources infect patients and invade bones in the same way and with the same ease. The great majority of cases are of human origin. The incidence of bovine infection varies in different countries and indeed in different parts of the same country. Nevertheless in every community the question of bovine infection is important since no form of tuberculosis is so readily prevented as that due to infected milk. Unfortunately, the investigation necessary to determine the incidence of bovine tuberculosis in any particular community is tedious, prolonged and expensive. Hence we have been prone to rely upon statistics compiled elsewhere, chiefly from European sources. These really have no bearing upon the problem of communities on this continent. That 50 per cent of Edinburgh's tuberculous children are suffering from bovine tuberculosis has no application to the problem here. Each state or province needs to compile its own statistics. Only by this means will accurate knowledge be acquired, and only accurate knowledge can lead to adequate control. For the Province of Ontario, the incidence of bovine infection in the surgical tuberculosis of childhood is approximately 15 per cent. Such cases all come from homes or communities where raw milk is consumed. To date none have been discovered in cities where adequate pasteurization is carried out. An example of the latter centers is the City of Toronto, where for many years pasteurization has been enforced by law. At the present time 10 per cent of the raw milk coming to the dairies contains tubercle bacilli. In spite of this, not a single case of bovine infection has been discovered during the past five years

in which an intensive study of the nature of tuberculous infections has been made. The importance of these observations lies in the ease with which bovine tuberculosis could be entirely eliminated. The painstaking establishment of tuberculous free herds would probably be the best means of attaining this end. But until that day is reached, pasteurization of milk offers a simple and certain means of eliminating bovine tuberculosis. I know of no simpler measure for wiping out 15 per cent of childhood tuberculosis.

Whether the patient be infected with human or bovine organisms the pathway of invasion is the mouth. Bovine organisms are swallowed with tuberculous milk and human organisms are breathed in on droplets of infected sputum with the inspired air. Within the body there is probably no essential difference in their action so that we may abandon any distinction between them. From the mouth, the actual invasion of the tissues takes place along one or more of three main pathways. (1) The bacilli may pass with the inspired air to the lungs where they are deposited in the alveoli and there set up the first focus of tuberculosis. (2) They may be swallowed and after passing through the stomach may invade the intestinal mucosa. (3) They may be deposited upon the nasopharyngeal mucosa and upon the tonsil and there produce primary foci of tuberculosis. Tubercle bacilli of the human type give rise chiefly to the pulmonary lesion, since they are air borne. Bovine lesions are chiefly responsible for the intestinal lesions because they are food borne. Both forms may give rise to tonsillar tuberculosis.

Wherever the tubercle bacilli may have been first deposited (lung, intestine or tonsil) there they set up the characteristic tissue reaction which gives rise to a tubercle. This is the primary focus. The dose of tubercle bacilli may be so small and the natural resistance of the patient so high that the infection is stamped out before it has an opportunity to spread further.

This probably is a rare event. More frequently the disease spreads, not by centrifugal expansion of the primary focus but by way of the lymph stream. In the childhood type of tuberculosis of which we are speaking, the primary focus remains small. Rarely does extensive involvement of lung or tonsil or intestinal mucosa occur. These are characteristics of the secondary invasions which occur during adult life. In childhood the spread of the primary focus is characteristically lymphatic. Tubercle bacilli leave the primary tubercle and pass in the lymph stream to the nearest lymph gland. There they are filtered out and there they set up fresh foci of tuberculosis. From this glandular focus the disease spreads, again by way of the lymphatics, to the next gland in the chain. By a series of such steps the infection spreads from gland to gland until the whole of the lymphatic chain draining the area of the primary focus becomes the seat of a tuberculous process. In this fashion there arises mediastinal adenitis when the primary focus is in the lung; mesenteric adenitis when the primary focus is intestinal, and cervical adenitis when it is tonsillar. By this time sufficient resistance against the disease may have developed to permit its complete eradication. Cure at this stage probably represents the type of tuberculous process through which the majority of us have unconsciously passed. On the other hand, the patient's resistance may only be sufficient to wall up the tuberculous disease behind mats of fibrous tissue where it lies latent, to flare into activity at some later date, when fatigue or intercurrent disease has lowered the patient's resistance.

In still other cases the disease continues to spread. Tubercle bacilli pass in the lymph from gland to gland until finally they reach the blood stream by way of the thoracic duct. More rarely the blood stream may be invaded directly by the rupture of a caseous gland directly into a blood vessel. The invasion of the blood stream and the establishment of a tubercu-

lous septicemia permits the dissemination of the disease to distant parts of the body. The numbers of organisms reaching the blood stream may vary within the widest limits, from the overwhelming infection which rapidly leads to death from miliary tuberculosis, to the isolated organism which is quickly disposed of by phagocytosis. In this consideration of the origin of bone tuberculosis the heavier infections do not concern us. They lead to the production of such myriads of new foci in all parts of the body that death quickly intervenes from miliary tuberculosis or tuberculous meningitis. Such heavy blood stream infections probably are relatively uncommon. It is likely that the less intense tuberculous septicemias commonly occur during the active stage of most cases of tuberculosis. From time to time, scattered showers of tubercle bacilli reach the blood stream from the primary focus or from its accompanying adenitis. In ordinary circumstances, it is probable that these scattered invaders of the blood stream are effectively disposed of by phagocytosis by the reticuloendothelial system. Occasionally, however, an organism or a group of organisms manages to gain a foothold in the tissues and there set up a fresh focus of tuberculosis remote from the primary source of the disease.

That blood stream invasion does occur during tuberculous infection is capable of direct proof. Several observers have recovered tubercle bacilli from the blood of certain cases of bone tuberculosis; one reports the incidence of positive blood cultures to be as high as 50 per cent. I have not found the organisms in the blood with anything like this frequency but in the examination of a comparatively small number of blood specimens I have twice recovered tubercle bacilli. One specimen came from a patient seriously ill with several foci of tuberculosis. He died shortly after the positive specimen of blood was obtained. The second was obtained from a patient with sacroiliac tuberculosis during a period when he was developing fresh bone foci. It is somewhat strange

that this examination of the blood is not more frequently carried out.

Amongst the most common of the hematogenous foci of tuberculosis, which result from this invasion of the blood stream, are those lesions of bones and joints which are grouped together under the heading of surgical tuberculosis. Tuberculosis of the spine and other forms of bone tuberculosis arise by invasion of the bone from the blood stream. It follows, therefore, that every patient with a focus of bone tuberculosis must be suffering from at least one other focus from which the blood stream has been infected. This is true, though it is commonly overlooked. A proper search in most of such patients will reveal evidence of the primary focus. In the majority of cases this will be a pulmonary lesion with its concomitant mediastinal adenitis. Less frequently, the primary focus will be found to be tonsillar or intestinal. Since the primary focus usually is inconspicuous and since its accompanying adenitis, on the contrary, is a prominent feature, the presence of the primary focus often must be deduced from the demonstrable adenitis. X-ray of the chest will reveal mediastinal adenitis when the primary pulmonary focus is so small as to be undiscoverable except by post-mortem examination. Similarly, tuberculous cervical adenitis may be accepted as evidence of a primary lesion in the tonsil. During the past five years it has been our practice to remove the tonsils of patients suffering from tuberculous cervical adenitis as a preliminary measure to removal of tuberculous glands. Examination of these tonsils by section and guinea pig inoculation revealed tuberculous lesions in more than 90 per cent.

Patients suffering from bone tuberculosis display other evidences of the generalized nature of their disease. If there has been a blood stream infection sufficiently heavy to produce one hematogenous focus, it is possible and even probable, that other foci have been laid down also. A careful search of such cases reveals this to be true.

More than half of the patients who suffer from bone foci have multiple lesions of hematogenous origin, either in other bones or in soft tissues. As a rule, one bone lesion is conspicuous, the remaining hematogenous foci inconspicuous. Yet it is a common experience to see patients with one or more bone lesions and with a variety of soft tissue foci.

Perhaps the most interesting of the soft tissue lesions which may accompany bone tuberculosis is tuberculosis of the kidney. It has not generally been recognized that tubercle bacilli can be recovered from the urine of such patients with remarkable frequency and that their presence in the urine indicates tuberculous disease of the kidney, even when no symptoms are present. One might expect to find tuberculosis of the kidney more frequently amongst patients with bone tuberculosis than amongst patients whose disease is limited to the lung. Renal tuberculosis is a blood borne infection; therefore, it will only appear in patients who have sustained a tuberculous septicemia. Patients who have bone tuberculosis have passed through such a septicemia. Moreover, it has been of sufficient intensity to give rise to focal disease. With blood stream infections of this intensity, it is not unreasonable to suspect the concomitant occurrence of renal foci. Every person who is called upon to treat cases of surgical tuberculosis must have noted occasional cases of renal tuberculosis develop under their observation. The incidence of these obvious cases is not great, but more careful examination will reveal that there are many cases of renal tuberculosis whose existence can be detected only by careful search.

The problem of how frequently renal tuberculosis accompanies tuberculous bone lesions has seemed to us to be worthy of investigation. Consequently, for the past seven years a prolonged investigation has been carried out which has yielded some interesting results. Our procedure is to examine carefully for tubercle bacilli the urine of patients suffering from bone foci.

Urine is collected with aseptic precautions in sterile receptacles. Part of this is examined chemically and stained smears are examined for tubercle bacilli. The sediment from the remainder is inoculated into a guinea pig. At the end of eight weeks the guinea pig is examined and the report recorded. As soon as this report is received, a second specimen is collected and dealt with in a similar manner. A series of such urinary examinations are carried out at intervals of two months as long as the patient is under observation. From each patient there is finally available a long series of urinary reports extending over eighteen months or two years, and in some cases as long as five years.

In all, there have been examined by this method 43 adult patients and 67 children. Of the adult cases 16 (37 per cent) were found to have tubercle bacilli in the urine intermittently or constantly. Among the children, 9 (13.4 per cent) were similarly positive. For purposes of comparison a similar series of observations were carried out upon a number of tuberculous patients without bone and joint involvement. Among these patients (49 in number) 4 (8.8 per cent) had tubercle bacilli in the urine. All 4 positive cases occurred in patients in whom gross invasion of the blood stream had taken place, as was evidenced by the presence of miliary tuberculosis or tuberculous meningitis.

This unusually high incidence of positive urines from patients with bone tuberculosis commands attention. It is far in excess of that generally thought to occur amongst patients with surgical tuberculosis. From my own experience, it may be stated that 5 to 10 per cent represents approximately the number of adult patients with surgical tuberculosis in whom frank renal tuberculosis develops. In children, the incidence is much lower. Naturally the first question which arises concerns the significance of the tubercle bacilli in the urine. Do they arise from tuberculous lesions in the kidney, or have they been excreted by the intact kidney from the blood stream?

Before answering this question, we must discuss briefly the nature of renal tuberculosis.

The term "tuberculosis of the kidney" is commonly used to describe a clinical entity characterized by definite symptoms (frequency, urgency and pain), definite urinary findings (pyuria, hematuria and the presence of tubercle bacilli) and pathological changes in the kidney which are macroscopic and gross in extent. Almost invariably these patients come under observation because of their symptoms. Attention is not directed to their urinary tract until frequency, pain and urgency lead them to consult a doctor. The symptoms are bladder symptoms and are due to involvement of the bladder in the disease, either by the passage through it of quantities of irritating material or more frequently by actual extension of the disease to the bladder. As commonly used, therefore, the term tuberculosis of the kidney really means tuberculosis which has commenced in the kidney but has now extended to the bladder and has given rise to symptoms. Of the course of the disease from the onset of symptoms to its termination by operation or death, we are thoroughly familiar; but of the course of the disease from the time the first tubercle bacillus is implanted in the kidney until the involvement of the bladder gives rise to symptoms which attract attention to the urinary tract we know almost nothing. We may term this the preclinical or silent phase of renal tuberculosis. Such evidence as is available leads us to believe that the silent phase is of long duration; that years elapse between the first invasion of the kidney and the extension of the disease to the bladder.

If we assume, for the moment, that tubercle bacilli in the urine of patients with bone tuberculosis come from foci of renal tuberculosis, then a considerable number of these patients are still in the silent phase of the disease. Thus, of the positive cases in adults, 9 (57 per cent) presented none of the usual symptoms of

the disease and in children, 8 (90 per cent) were similarly free from symptoms.

There remains the question as to whether tubercle bacilli in the urine indicate foci of tuberculosis in the kidney, or whether they result from an excretory bacilluria. Extensive investigation into this question leads me to the belief that excretory bacilluria never occurs and that the presence of tubercle bacilli in the kidney urine indicates the presence of renal tuberculosis. The more important reasons for this belief are as follows:

1. The assumption that the intact kidney can excrete tubercle bacilli or other organisms, or indeed any formed particles, is not based upon any facts. Indeed, all the experimental evidence available points to the opposite conclusions. The careful work of Helmholtz and his associates demonstrated that organisms never appeared in the urine of an animal following their injection into the blood stream, unless they first produced foci in the kidney. The similar work of Medlar for tubercle bacilli indicates that the presence of these organisms in the urine of an animal following their injection into the blood stream always is accompanied by the occurrence of renal tuberculosis. No experimental or clinical fact has yet established the ability of the kidney to excrete organisms or formed particles of any kind.

2. The tubercle bacilli when present in the urine of these patients are always accompanied by pus cells. The intensity of the pyuria varies greatly and often the number of leucocytes is small. There is a rough parallelism between the number of tubercle bacilli, the number of pus cells and the intensity of the symptoms when these are present. In every positive case, some pus was present. These must come from inflammatory foci, and it is fair to assume that they arise in foci of tuberculous inflammation in the kidney.

3. The kidneys of eight patients who had positive urines have been examined, either after operation or post mortem. In every case, tuberculous disease was

found. In some, the lesions were of the usual caverno-caseous type, but in others the foci were small and sometimes few in number. The majority of the kidneys having small foci showed some evidence of healing.

4. From several of the patients daily specimens of urine were collected for a period of two or three weeks and each sample inoculated into a separate guinea pig. In due course, all the guinea pigs developed tuberculosis, demonstrating the constant presence of tubercle bacilli in the urine. Were this due to excretion of tubercle bacilli by the kidney, it must necessarily have been accompanied by the constant presence of tubercle bacilli in the blood. Yet examination of the blood for tubercle bacilli by guinea pig inoculation was negative and the patients did not then and have not since presented any evidence of miliary tuberculosis.

It may be assumed with reasonable certainty, therefore, that the presence of tubercle bacilli in the urine of patients suffering from bone tuberculosis indicates the existence of renal tuberculosis. If this be granted, it is evident that renal tuberculosis occurs more frequently than has been suspected. This discrepancy is very marked in the case of children. During the ten years ending in December, 1926, there were admitted to the Hospital for Sick Children in Toronto 392 patients suffering from bone and joint tuberculosis. Amongst these, the diagnosis of renal tuberculosis was made once (approximately 0.25 per cent). During the succeeding eighteen months, careful examination of the urine revealed positive samples (and presumptively renal tuberculosis) in 13.8 per cent of the cases.

It is of interest to speculate upon the outcome of these cases. Will they progress to frank renal tuberculosis with symptoms, or do some of them undergo spontaneous cure? Too short a time has yet elapsed to answer these questions definitely, but evidence is accumulating which points to spontaneous cure in certain cases. At

any rate, several patients whose urine for a year or more contained tubercle bacilli and pus are now free from these evidences of renal tuberculosis and are free from symptoms. It is commonly stated that renal tuberculosis once established steadily progresses to ultimate destruction of the kidney. But such statements are based upon the experience of genitourinary surgeons, who first see the disease when in a comparatively advanced stage. When gross destruction has occurred, spontaneous cure is not likely to occur. But it is otherwise with the early symptom-free and probably microscopic lesions which can be discovered by routine examination of the urine. It is probable that we must revise our conception of the early pathology of tuberculosis. In this province, the surgeon dealing with bone tuberculosis has an opportunity to gather data which frequently is denied the genitourinary surgeon.

#### SUMMARY

The occurrence of tuberculosis in bones

and joints is but an incident in the dissemination of the disease. It has been possible for it to occur because of the presence of tubercle bacilli in the blood stream. The blood stream in turn has been infected from some preexisting focus of tuberculosis. By reason of its hematogenous origin, bone tuberculosis is prone to be accompanied by other foci in bones and soft tissue which similarly have been infected from the blood stream. The more careful the search, the more numerous will be the lesions found. Renal tuberculosis is particularly prone to accompany bone lesions. In the management of cases of bone tuberculosis, therefore, four things are incumbent upon us: (1) to determine, if possible, the outside source from which the patient was infected, (2) to find his primary focus, (3) to examine him carefully and repeatedly for evidences of concomitant foci, including renal foci, and (4) to treat him as a patient who is suffering from generalized tuberculosis rather than one whose only lesion is in the joint of which he complains.



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# SPONDYLOLISTHESIS

WITH A REPORT OF FOUR CASES\*

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THE purpose of this communication is to report 4 cases of spondylolisthesis in which the dislocation of the fifth lumbar vertebra was evidently due to a congenital deformity of its posterior arch. In 2 cases there was a cleft in the pedicles with wide separation of the superior and inferior articular processes of the fifth lumbar vertebra. In the other cases the laminae were attenuated and abnormally long.

Intensive studies in the anatomy of the back and the pathology of lesions of the spinal column are gradually clarifying what, in the past, have been rather confused notions of certain spinal deformities. It used to be taught that spondylolisthesis was a deformity found only in women. In the last two decades many instances have been seen in men, and in them the lesion was frequently first recognized after an injury. Having treated some cases of spondylolisthesis in laborers, in whom the symptoms and the deformity appeared after a single severe trauma, I was for a time strongly under the impression that, in some cases at least, the lesion was purely traumatic, in the same sense that we speak of a traumatic dislocation of the shoulder or hip joint, the dislocation in the spine being made possible through a fracture of one or both sides of the neural arch. Dr. John Dunlap of Los Angeles in discussing Dr. Elsie Asbury's paper on spondylolisthesis reported 6 patients operated on at the Los Angeles General Hospital, in every one of whom the surgeons found a fracture of the laminae. No evidence was presented in this article to confirm these findings or differentiate them from a possible congenital lack of fusion of the laminae. In view of the studies of Goldthwaite and Willis, the reports of Turner, Shore and Blairsford and my own recent observations, I have

been led to modify my conception of the etiology and pathogenesis of spondylolisthesis.

Ever since Thomas Dwight called attention to the fact that the fifth lumbar vertebra had so many morphological variations that he could not describe what constituted a *normal* fifth lumbar vertebra, many observers have recorded a large number of congenital lesions in the lumbosacral area. The most important of these in relation to spondylolisthesis is a congenital cleft in the pedicles due to lack of fusion of the superior and inferior articular processes of the fifth lumbar vertebra on one or both sides. Normally there is only one center of ossification for each lateral mass of a vertebra. When this is split and there are two centers of ossification, the processes developed from them may not fuse. As a result of this the superior articular process is attached to the vertebral body, the inferior articular process joins the lamina, and there is a variable space between these processes filled in by connective tissue. The laminae usually unite posteriorly to form the spinous process; they may, however, remain separate and unfused, resulting in an absence of the spinous process. In the latter condition the defect is distinctly visible in the roentgenogram. When these anomalies are present the vertebral body and the neural arch are held together only by ligaments, and hence they may be separated by any injury sufficiently severe to tear or stretch the ligaments. When, in recent years, cases were said to be traumatic in origin, objection was raised on the score that the alleged accidents were not severe enough nor of a nature to cause a fracture, and that the lesion was, therefore, not traumatic. In the light of our present knowledge the etiology in these cases

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becomes apparent. If the injury causes a laceration of the ligamentous tissues, a strong check is removed, and the super-



FIG. 1. Case 1. Side view, showing prominence of sacrum and marked hollow in lumbar region. The back is flat. The prominence of the iliac crests is not visible in this view.

incumbent weight of the trunk causes a sagging or dislocation of the vertebral body. This was evidently the mechanism of the dislocation in the first 2 cases here reported.

An increase in the lumbosacral angle is another potent factor in the causation of spondylolisthesis. There may be combined with this a change in the shape of the superior surface of the sacrum. The upper surface of the sacrum may be convex and its anterior half slope downward and forward, as is distinctly seen in the lateral x-ray picture of my first case. In this anomalous condition the strains and stresses of the body weight tend, during ordinary occupation and without any single severe injury, to initiate a subluxation of the last lumbar vertebra.

An alteration in the plane of the lumbosacral joints would also favor subluxation of the fifth lumbar. We know that the articular processes of the lumbosacral joint vary a great deal in the shape, position and direction of their articular facets. The articular processes are frequently not symmetrical. The outline, size and general inclination of the joint on one side may be different from those on the other side. The plane of the articulation on either or both sides varies from the vertical to the horizontal position. Thus while in the normal state of the lumbosacral articulation a dislocation is not possible because of the relation of the articular processes of the fifth lumbar and sacrum, when the plane of the joint is altered so that it is oblique or horizontal, the processes can readily slip past each other.

Dr. J. C. Edgar in his textbook on "The Practice of Obstetrics" suggested long ago that the subluxation of the vertebral body in spondylolisthesis may be due to an elongation of the laminae. In two of the present group of cases and in others I have studied, the lateral x-ray film showed what did appear to be abnormally thin and very long laminae without any break in their bony continuity. More convincing proof is now offered by Dr. Brailsford of England who reports 5 cases and 1 specimen of spondylolisthesis. In all but one of these the laminae were elongated and showed no solution of continuity. He noted further that in the anteroposterior films the neural arch increased in width from the second or third lumbar down to the middle of the sacrum. This increase is due to a lengthening of the laminae. The changed structure of the laminae is the result of a congenital malformation or perhaps a sequel to an injury during childhood.

The relation of injury to spondylolisthesis is difficult to estimate accurately. In most of the cases I have seen the symptoms appeared directly after an injury. Dr. Elsie Asbury of Cincinnati, Ohio, in a study of 27 cases found that trauma played an important part in 23 of them. Most authors are agreed that

trauma is a prominent factor in the etiology of the majority of the cases.

When we consider spondylolisthesis as

that he could not run as fast as his comrades or as fast as he used to. During the summer months he went swimming and apparently had

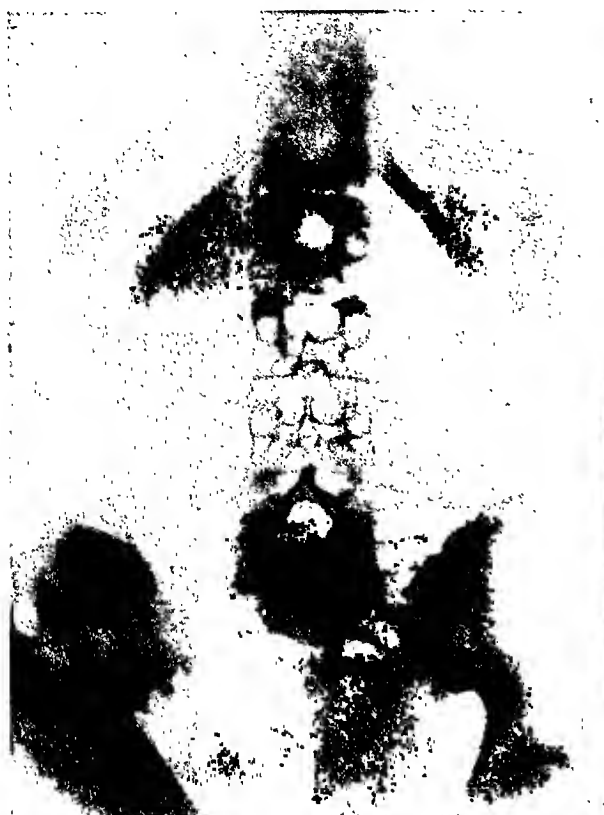


FIG. 2A. Case 1. Characteristic crescentic shadow of body of fifth lumbar vertebra in front of upper part of sacrum. Defect in neural arch of fifth lumbar is clearly shown.



FIG. 2B. Case 1. Anteroposterior view made at lower level than that shown in preceding figure. Outlines have been purposely emphasized by pencil to show more clearly defects in fifth lumbar and sacrum.

occurring in an individual who is predisposed to this lesion by reason of certain congenital bony maldevelopment or anomalies, it is readily understood how a single severe trauma or a succession of injuries may operate in bringing about a true dislocation with motor and sensory disturbances and a variable degree of disability.

#### CASE REPORTS

**CASE 1.** Lionel S., fourteen years old, was referred to me in September, 1928 for pain in the lower part of his back, pain in his lower limbs and difficulty and awkwardness in walking. He was apparently well until March, 1928 when, while climbing up a hill, he stumbled and fell backward, striking the lower part of his back against a rock. He had only moderate pain at the time and after a few days forgot the accident. He returned to school and finished his term. During March and April, 1928, he engaged in the usual exercises and games with his playmates. In May, however, he found

backache only when he chanced to brush against someone, or somebody pressed against his back. He does not remember when his awkward gait appeared. Soon after the injury he began to have pain in the back of his lower limbs. The pain gradually increased and recently became severe. The pain has always extended from his back down the back of both thighs and legs to the ankles.

My notes of September 26, 1928 read as follows: The boy is very tall for his age, thin and anemic. He walks without assistance but very awkwardly, swaying his pelvis. There is a very peculiar deformity of his back as is seen in Figure 1. His back is symmetrical. The sacrum and iliac crests are very prominent. Immediately above the sacrum the spine curves forward sharply, so that there is an exaggeration of the lumbar curve. The lordosis includes all the lumbar and the lower dorsal vertebrae. There is a reduction in the normal backward curve of the upper dorsal vertebrae, so that the patient has a flat back. There is exquisite tenderness upon pressure over the lumbosacral

area. The motions of the spine are markedly restricted in all directions. There is no disturbance of sensation. The reflexes are normal.



FIG. 3. Case 1. Lateral view showing anterior dislocation of body of fifth lumbar, and interval between body and lateral mass of fifth lumbar. Axis of sacrum is nearly vertical.

The roentgenograms are characteristic of spondylolisthesis. In the anteroposterior view, Figure 2, the upper 4 lumbar vertebrae have the normal outlines. The fifth lumbar is not above the sacrum. Instead, one sees a typical crescentic shadow in front of the first sacral segment. This is the body of the fifth lumbar. Immediately above the sacrum there is an elongated process of bone parallel with the upper border of the sacrum (Fig. 2 A). This, which I assumed to be the neural arch of the first sacral segment, proved, at operation, to be the malformed neural arch of the fifth lumbar vertebra. The outlines of the vertebrae were, for convenience, emphasized by pencil in the original film before copies were made for publication. In the lateral view (Fig. 3) the body of the fifth lumbar is seen to be displaced forward. There is a gap or cleft between the body and the lateral mass. It is noted also that, as Dr. Goldthwaite has pointed out, the axis

of the sacrum is more vertical than in the normal individual.

This patient has, therefore, an advanced degree of forward dislocation of the fifth lumbar vertebra. From the course of the boy's illness, the chief element of which was progressive aggravation of backache and disability, we may conclude that the dislocation, made possible by the existence of a defect in the structure of the fifth lumbar, started at the time of the injury and gradually increased. The injury was but like a spark starting a flame. It caused a tear or stretching of the ligamentous tissues holding the bony elements. Subsequently there was a progressive slipping of the vertebral body with the appearance of a deformity of the spine and nerve symptoms causing practically complete disability.

In the hope that we might effect some measure of reduction by favorable posture and traction, the patient was placed in bed, the thighs flexed and traction applied to the head and to the thighs in the direction of the axes of the femora as shown in Figure 4. Within several days the pain in the thighs and back and the tenderness in the lumbosacral area disappeared completely, and the boy was comfortable for the first time in several months. Upon palpation of the spine it was found that the lumbar area was flat instead of hollow. The depression above the sacrum was gone. From these observations it was hoped that the dislocation was partly reduced. The x-ray pictures, however, showed that there was no such fortunate result. As the pain was relieved I concluded that the traction did remove pressure from the lumbar nerves.

The next step in the treatment was inevitably a spine fusion for the purpose of uniting the lower lumbar vertebrae to the sacrum, and preventing further displacement of the fifth lumbar vertebra. The stabilization of the entire lumbosacral area would tend to relieve the pressure on the nerves and the disabling pain.

The operation was performed about three weeks after the patient's admission to the Hospital for Ruptured and Crippled. The posterior arches of the second, third, fourth and fifth lumbar vertebrae and of the upper part of the sacrum were bared of periosteum. The pathological findings noted at the operation are represented in the accompanying sketch (Figure 5) made for me by the then House Surgeon, Dr. M. H. Herzmark, who assisted me. The fifth lumbar vertebra did not have a

spinous process. The laminae were not fused. There was an interval between the two lateral masses of the fifth lumbar of at least a half-

CASE 11. John McC., twenty-three years old, came to my clinic at the Hospital for Joint Diseases in December, 1929. His chief com-

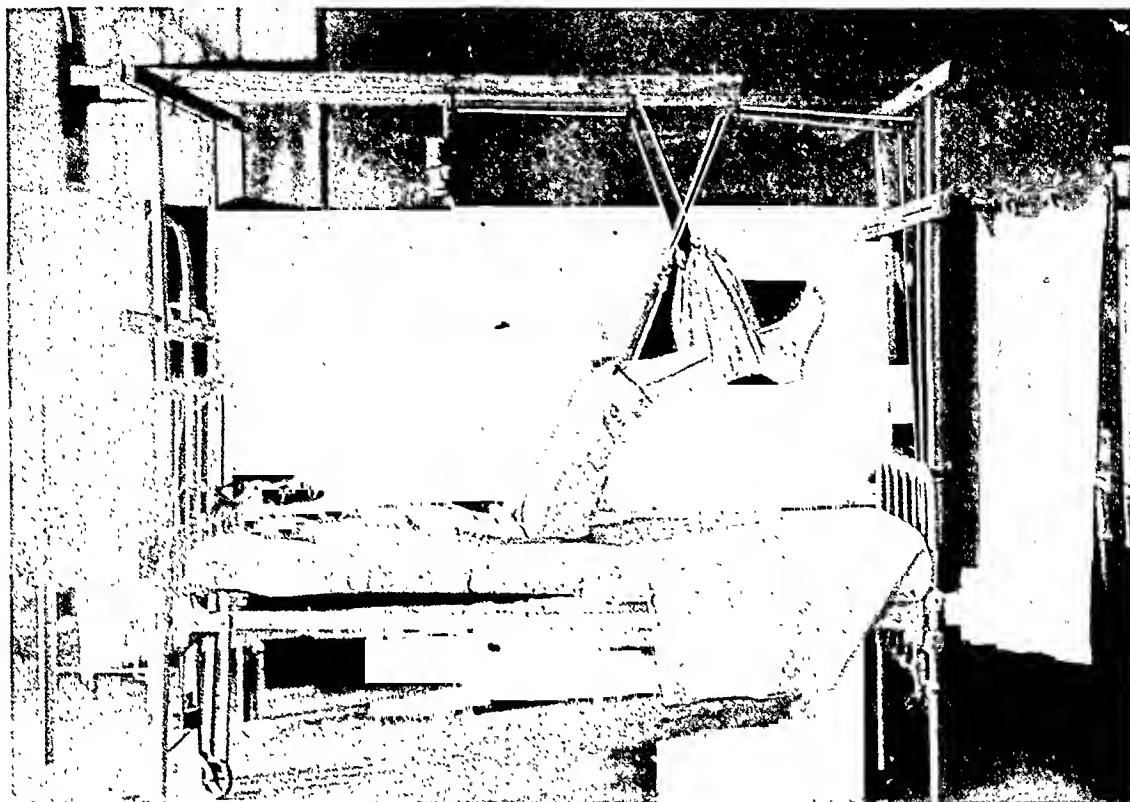


FIG. 4. Case 1. Traction applied to head and lower limbs. This relieved pain in back and legs.

inch. The posterior arch of the fifth lumbar vertebra was abnormally movable and the two lateral masses were movable upon each other. On the right side the lamina and transverse process were easily identified. On the left side the mass of bone exposed in the wound was evidently the posterior extremity of the lamina. The transverse process could not be found. Apparently there was rotation of the vertebra as a result of which the anterior part of the lamina and the transverse process on the left side were so deeply placed that they did not come into view. The lateral masses of the fifth lumbar vertebra articulated with the sacrum. Beyond the articulations the lateral masses of the sacrum were visible for a distance of about a half-inch. There was a wide defect in the posterior arches of the first and second sacral segments. A large beef bone graft was inserted on the left side of the spine from the second lumbar to the third sacral segment.

Eight weeks after the spine fusion the patient was discharged from the hospital wearing a Knight spinal brace. At present, one year and a half after the operation, he walks about comfortably and has no pain.

plaint was weakness of the back, and pain in the lower part of his back and along the posterior aspect of the right lower limb. His symptoms came on gradually about a year ago, after he had engaged in lifting some heavy weights. This patient had several severe falls that probably contributed to the present disability. Three years ago he fell and was so severely hurt that he was unconscious for ten minutes. On another occasion, in trying to save himself during a fall, he fractured his right foot. But the backache is only of about a year's duration and is at present aggravated by any strong muscular exertion.

The patient is a young man apparently in excellent general condition. He walks without assistance but awkwardly. His back is symmetrical. The trunk is inclined forward and slightly to the right. There is marked prominence of the sacrum and a hollow above the sacrum. The dorsal area is unusually flat. Flexion and lateral bending of the spine are free. Hyperextension is moderately restricted. There is no tenderness to pressure over any part of the back.

The lateral x-ray picture (Fig. 6) shows a

marked forward subluxation of the fifth lumbar vertebra. The anterior surface of the body is three-fourths of an inch in front of that of the

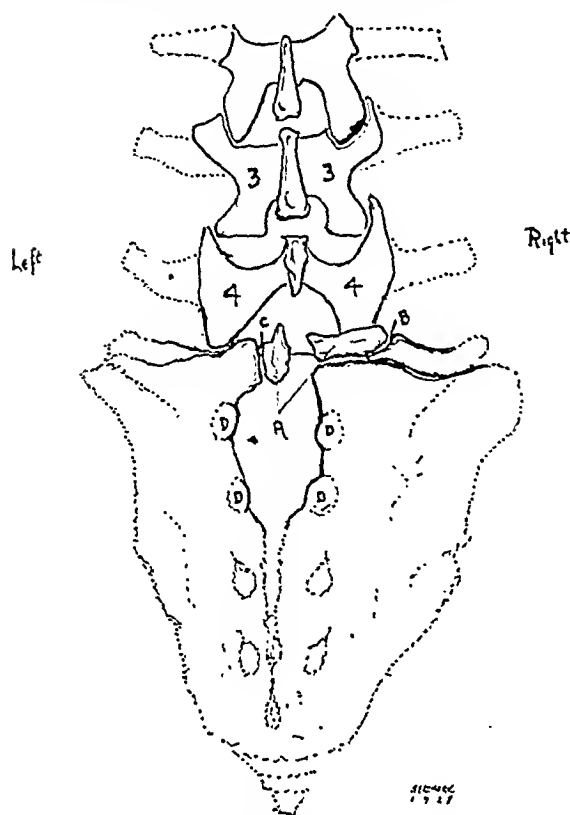


FIG. 5. Case 1. Operative findings. A. Laminae of fifth lumbar with a wide gap between them. B. Facets of right lumbosacral articulation nearly horizontal. C. Facets on left side are vertical. D. Extremities of laminae of first and second sacral segments with large defect in neural arches.

sacrum. The body of the fifth lumbar is wedge shaped, with the base corresponding to the anterior surface. The vertical diameter of the posterior surface of the body of the fifth lumbar is less than half of that of the anterior surface. There is a very wide gap between the pedicle of the fifth lumbar and its spinous process which remains aligned with that of the first sacral segment. The upper lumbar vertebrae appear normal and are all displaced forward and aligned with the body of the last lumbar vertebra. The upper surface of the sacrum is convex upward. The long axis of the sacrum is almost vertical.

This is evidently a case of congenital spondylolisthesis, like the preceding one, in which there is a lack of fusion of the front and back portions of the laminae. The division is through the pedicle, the superior articular process

remaining attached to the body, and the inferior articular process to the lamina. This is shown particularly well in the x-ray picture.

This patient had a number of accidents and injuries, any one of which might have caused a tear of the fibrous tissue uniting the segments of the neural arch of the fifth lumbar, predisposing to the dislocation. The patient himself noticed that the "hollow" in his back increased after heavy lifting. As the deformity is getting worse the patient was advised to have a spine fusion. He has, however, refused consent and has continued to work despite his evident disability.

CASE III. Mrs. R. G., thirty-eight years of age, came to my clinic at the Hospital for Joint Diseases on May 8, 1929, complaining of pain in the lower part of her back. The pain radiated down the back of both thighs and the lateral surfaces of the legs. The pain is most marked in the morning. It disappears by noon, after which she can walk, work and attend to all of her household duties. The symptoms came on about six years ago without any known injury. The patient believes her backache due to her many pregnancies. Although she is only thirty-eight years old she has given birth to 9 children and has had several miscarriages.

The examination of this patient is negative except for an increase in the lumbar hollow. The back is symmetrical. The spine is freely movable and the motions are painless. There is no hollow above the sacrum and no sensitiveness to pressure. There is no disturbance in the reflexes of the motor or sensory functions. The lateral x-ray picture (Fig. 7) shows an anterior subluxation of the last lumbar vertebra. The anterior border of the body of the last lumbar is at least one-quarter of an inch in front of that of the sacrum. The neural arch of the last lumbar is in its normal position, but there is a marked elongation of the laminae of the last lumbar.

This case appears to be one of a purely congenital spondylolisthesis resulting from an elongation of the laminae of the last lumbar vertebra. The numerous pregnancies have probably had no effect on the bony structure of the lumbosacral area, but have caused a chronic sprain of the lumbosacral articulations, resulting in backache. The patient has been relieved by wearing a corset and, for the present, needs no operative fixation.

CASE IV. Mrs. J. K., thirty-two years old,

consulted me on November 5, 1929, for pain in the lower part of her back and a burning sensation in the right thigh. This patient had

culty, pain or effort. There was a very distinct hollow in the middle of the back above the sacrum (Fig. 8). What I thought was the

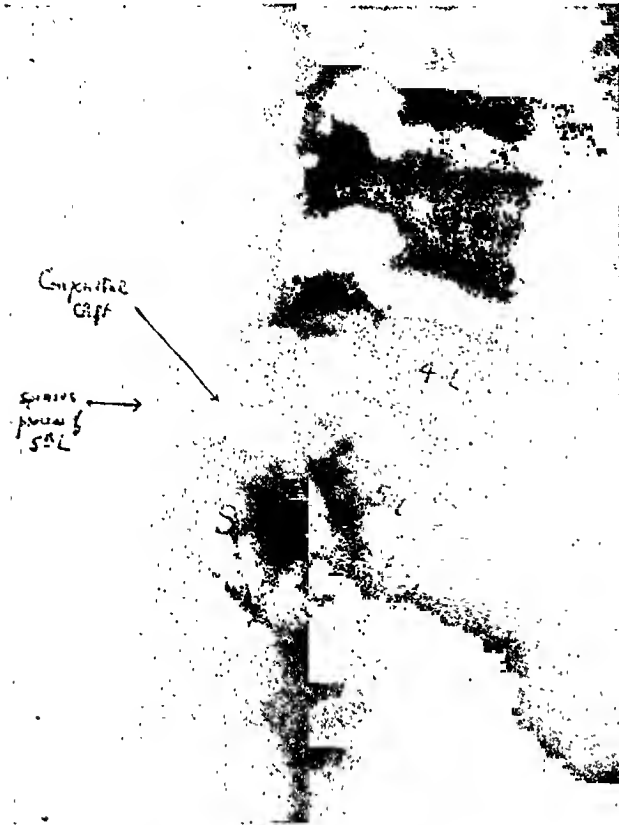


FIG. 6. Case II. Lateral roentgenogram shows defect in laminae with wide separation of body and spinous process. Note convexity of superior surface of sacrum, favoring dislocation of fifth lumbar.



FIG. 7. Case III. Lateral view showing subluxation of fifth lumbar vertebra. Laminae of fifth lumbar are elongated.

not had any backache until last summer, when she first noticed some discomfort in the lumbar area. At this time she was in a camp, and, as she had been very active, swimming, diving, playing tennis and engaging in other outdoor sports rather vigorously, she attributed her backache to excessive exercise. She did not recall any severe injury, and did not believe that the exercise had brought on the backache as she had always been athletic and frequently indulged in considerable outdoor activity. However, the pain increased and finally became so severe that she could not walk. A rest of several weeks improved her immensely, but the backache has continued in mild form. When she returned to the city in the fall she related her experiences to her brother, who is a physician. He examined her and found a deformity of the spine. Neither she nor her brother had noticed the deformity previously and did not know how long it had been in existence.

My examination showed a well-developed individual who walked without a limp, diffi-

spinous process of the first sacral segment, but proved from the x-ray picture to be that of the last lumbar, was very prominent. Flexion of the spine was markedly restricted; the other motions were only moderately limited. There was no sensitiveness to pressure over any part of the back. There was no change in the sensory or motor functions, but there was a distinct exaggeration of the reflexes and a tendency to ankle clonus on the left side.

The x-ray picture (Fig. 9) showed a marked forward subluxation of the fifth lumbar on the sacrum. The spinous process of the fifth lumbar is in normal relation with that of the sacrum. The laminae of the fifth lumbar are, as in the last case, elongated, but show no cleft or defect. The laminae of the other lumbar vertebrae are normal in size. The body of the last lumbar is displaced forward so that half of it is in front of the sacrum.

In this patient, as in the last, I believe that the deformity is congenital and due to abnormally long laminae with resultant forward slipping of the body of the last lumbar vertebra.

The 4 cases here reported show 2 types of lesion: (1) a defect or split in the pedicles of the last lumbar vertebra with separation

done by strenuous gymnastic exercises caused a strain of the lumbosacral articulation and resultant backache. In the first



FIG. 8. Case iv. Side view showing prominence of sacrum and hollow above sacrum.

of the articular facets which are held together only by connective tissue; (2) an elongation of the laminae of the last lumbar vertebra. As the spinous process of the last lumbar remains in normal relation with that of the sacrum, its body is naturally displaced in front of that of the sacrum. In all the cases trauma was an important factor. In the first 2 cases the injury caused a tear of the connective and ligamentous tissues uniting the articular processes and made it possible for the force of gravity and weight bearing to produce a forward dislocation of the vertebral body. In the third case the injury incident to the numerous and frequently repeated pregnancies, and in the fourth case the injury



FIG. 9. Case iv. Lateral roentgenogram. Shows marked displacement of fifth lumbar and elongation of laminae without any break in continuity.

type of lesion, in which there is a break in the bony wall of the neural arch, a spine fusion is imperative to relieve existing symptoms and to prevent future increase of the dislocation. In the second group, one should always first attempt to relieve the symptoms by some form of external spinal support, and only in case of failing to help the patient should one resort to an operative fixation of the spine.

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#### DISCUSSION

DR. EDWIN PYLE: Of the cases that I have operated upon or seen operated on not one has failed to show defects in the laminae. In many of the x-ray examinations before and after, it was impossible to see the defect. I believe they all have it; but if one part of the lamina is superimposed on the other so that the x-rays do not pass directly through the defect. I do not think it will show on the x-ray plate.

The prominence which is felt just below the exaggerated lumbar lordosis is not the superior surface of the sacrum but the spinous process of the fifth lumbar vertebra.

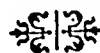
DR. MATHER CLEVELAND: The lumbosacral junction is subject to a great many variations, and of the less frequent variations that we see is this: spondylolisthesis. We not infrequently see cases with rather severe backache and with no spondylolisthesis where there is a failure

of fusion between the laminae and pedicles of the fifth lumbar vertebra; in other words, due to an unstable lumbosacral junction. It so happens that in the Anatomical Department of Columbia a skeleton very beautifully illustrates the point that Dr. Kleinberg has mentioned, this failure of fusion between the laminae and pedicles of the fifth lumbar vertebra. This represents a potential spondylolisthesis, but not an actual one. I think that many individuals who have this condition are all set up for spondylolisthesis but may never develop it.

DR. ARMITAGE WHITMAN: I have been much interested in Dr. Kleinberg's paper and Dr. Cleveland's remarks, because at the May, 1924 meeting of the American Orthopedic Association I reported a group of 5 cases with a description of the history, clinical and x-ray findings, and the surgical anatomy based on the operation performed on 1 case. They were all cases of great exaggeration of the lumbosacral angle. In 2 cases there was demonstrable forward displacement of the fifth lumbar on the first sacral vertebra. In the others there was none, but the predisposition to displacement was self-evident. I described the condition under the term "Prespondylolisthesis."\* It gives me pleasure to report that the only case of a patient in the group operated upon in which a combined fusion and tibial graft was performed is at the end of seven years completely well, married, and engaging freely in all forms of physical activity.

DR. KLEINBERG, *closing*: I have but one word to add. I have been very much interested to find out the exact incidence of spondylolisthesis. I have here some figures which Dr. Pomeranz, radiographer of the Hospital for Joint Diseases, was kind enough to give me. In the year 1929-30 1655 spines were x-rayed at the Hospital for Joint Diseases. In this group 4 instances of spondylolisthesis were found. These figures will indicate that the incidence of spondylolisthesis amongst pathological spines is about one-fourth of 1 per cent.

\* *J. Bone & Joint Surg.* October, 1924.





# CHEMISTRY AND PHYSIOLOGY OF CALCIFICATION\*

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TO those in the audience who may be chemists I should like to speak as a physiologist; to those who may be physiologists I should prefer to claim the privileges of a chemist; those who, like myself, are neither physiologist nor chemist, but interested students of both sciences, will sympathize with me if I temper the austerity of chemistry with a touch of physiology in an attempt to escape the dilemma into which the exponents of purely chemical or purely physiological points of view have been thrown. With such a pragmatic attitude it seems possible at the present time, while admitting ignorance of the exact nature of the forces behind certain of the phenomena concerned and the existence of large gaps in our knowledge, to build up a useful and coherent picture of the nature of the process of normal calcification, or bone formation, and the factors influencing it.

In simple terms calcified bone may be considered to be a solid precipitate of calcium salts in contact with a solution containing the same salts. Bone is composed chiefly of calcium phosphate and calcium carbonate. From a chemical point of view it is possible and simpler for many reasons to discuss the problem as if the bone were a simple deposit of calcium phosphate. As evidence that such a view is substantially correct certain simple experiments may be cited: First, the fact that bone is decalcified *in vitro* in solutions in which its salts are soluble; second, the fact that calcium salts are deposited in an orderly structure resembling normal bone formation in growing bone suspended *in vitro* in normal serum. In a system consisting of a solid salt in contact with a solution of that salt, under any given conditions an equilibrium will be reached when the solution is saturated with the salt. At this point no more is precipitated out or, in

more dynamic terms, the quantity which is at any time dissolved is equalled by the quantity which is at the same time precipitated. Any condition which increases the solubility of the salt will cause part of the precipitate to dissolve; anything which reduces solubility will cause precipitation of some of the dissolved salt. Heat, cold, change of reaction are factors that commonly change the solubilities of salts and therefore influence precipitation.

Another important factor is the concentration of the individual components of the salt in question, the solubility product of mass law fame. In a saturated solution of sodium chloride containing precipitated sodium chloride, under any given environmental conditions, the solubility product law says that the product of the concentrations of sodium and chloride will remain constant. The addition to the solution of either sodium or chloride will cause precipitation of sodium chloride. Therefore, calcification must depend not only on the amount of calcium but also on the amount of inorganic phosphate in the solution in contact with bone. An increase of either component will increase precipitation (that is, calcification); a diminution of either component will further solution (that is, cause calcification). The simple fact that the deposition of calcium phosphate could not depend on calcium alone would hardly seem to require such complex scientific explanation. It seems almost as obvious as the fact that one can not make ham and eggs out of ham. Nevertheless, the literature is full of figures attempting to relate calcification to serum calcium or, more rarely, to serum phosphate, alone; and surprised, sometimes almost petulant remonstrances at the uselessness of chemistry when no clear correlations are found.

In spite of all my preparatory apologetic defenses I dare not set sail from the quiet

\* Presented before the Section of Orthopedic Surgery, New York Academy of Medicine, April 18, 1930.

waters of the test tube into the more stormy biological deeps without serious provision against the chemical pirates who may be lying in wait for me. Chemically there is some question concerning the state of saturation of the serum with calcium phosphate and the proper manner of calculating solubility products. Some claim that bone is composed of tricalcium phosphate and that the solubility product must be calculated as the cube of the calcium times the square of the phosphate; others insist that bone is composed of acid calcium phosphate and the solubility product should be estimated merely as calcium times phosphate. The question is whether ham and eggs are two pieces of ham and 3 eggs or a slice of ham to each egg. This evening I shall let the two parties fight between them, content if only I can sail around them with both ham and eggs in any reasonable proportions.

For the purposes of the present discussion, then, I shall make the reasonable assumption that serum is a solution in which calcium and inorganic phosphate exist in such concentrations that the solution is always nearly or quite saturated with calcium phosphate. If there is still objection to this statement on the ground that it cannot be mathematically and chemically substantiated, I shall fall back on my physiological privileges and say it is biologically or effectively saturated in the sense, that it acts qualitatively like a saturated solution as far as calcification is concerned. Some may object to my speaking of blood serum as the fluid that bathes bone. To these I answer that it is the transportation system on which any fluid more contiguous to bone must depend for its supply of calcium and phosphate and with which such a fluid must presumably be in equilibrium. Moreover, experiments of Arnold and Mendel have shown that the composition of lymph mirrors that of serum exactly as far as calcium and phosphorus are concerned.

Even such a defensive phrase as "biologically saturated" demands a word of

explanation. In a pure solution of salts having a composition such as that of serum it is impossible to dissolve as much calcium phosphate as is normally held in serum. If protein is added to such a solution more calcium will dissolve. In serum and other calcium-containing body fluids the calcium concentration varies directly with the amount of protein in the fluid. Thus there is less calcium in lymph, transudates and spinal fluid, which contain little protein, than there is in serum. This extra dissolved calcium which, chiefly through experiments of Robert Loeb,<sup>1</sup> we have reason to believe exists combined with protein as calcium proteinate, appears to play little or no part in the process of calcification. One might say that it is unavailable for formation of calcium phosphate or, to return to our homely simile, this ham cannot be used to make ham and eggs because it has already been made into ham sausage.

From the standpoint of disease it is important to recognize this inactive portion of calcium. In certain types of nephritis, especially the picture spoken of as nephrosis, the serum calcium may fall to extremely low levels without the appearance of tetany or any evidences of decalcification, phenomena that are recognized as signs of calcium deficiency. In these cases the reduction in calcium appears to affect chiefly the inactive fraction attached to the serum proteins which, in these conditions, are greatly reduced. Malnutrition is another condition in which serum proteins and calcium fall together. This may afford an explanation for the slightly lowered serum calcium of advanced tuberculosis to which some observers have tried to attach importance. In pregnancy, also, serum proteins are low and a slight calcium deficiency has been demonstrated. These deficiencies have no apparent bearing on calcification processes. Their practical significance lies chiefly in the fact that, if serum calcium figures are to be evaluated in relation to calcification the concentration of protein in the serum must

be taken into consideration. In fact it is doubtful whether one can safely interpret serum calcium figures unless both protein and phosphate concentrations are also known. Therefore, it is safer routine practice to determine all three when clinical information is desired.

Even allowing for the inactive protein-bound calcium, serum holds in solution more calcium than would an artificial solution of the same composition. One must, then, recognize a third fraction of calcium which is held in solution by virtue of certain peculiar biological properties of the body media. This fraction, moreover, appears to be physiologically active and concerned with the processes of calcification. The factor which can be most clearly recognized as contributing this extra calcium dissolving power to serum is the internal secretion or hormone of the parathyroid gland.<sup>2,3</sup>

There are, then, three separate fractions of calcium in the serum and body fluids to be functionally distinguished. These may be spoken of as chemically dissolved calcium, biologically dissolved calcium, and calcium combined with protein. The first two, chemically and biologically dissolved, are in equilibrium with phosphate and concerned with calcification and bone formation; the protein fraction is not.

With only these premises why should calcium phosphate be deposited in one place rather than another? The answer to this question can be approached from either the negative or the positive side. From the negative side certain facts of interest appear. Calcium cannot precipitate in the red blood cells, for example, because these cells contain no calcium. Muscle cells appear to contain very little calcium and large amounts of protein. For the preservation both of our theory and of these cells this is fortunate, because muscle cells contain, at times, such large quantities of phosphate that calcium precipitation within the cells would inevitably occur if calcium were present in high concentration. From the positive side we

are left with the fact, first established by Shipley and Kramer,<sup>4</sup> that growing bone suspended in normal serum undergoes active calcification *in vitro*. This calcification is dependent upon some vital property because it is prevented by protoplasmic poisons. Other tissues treated in the same manner do not become calcified. Such a phenomenon could be easily explained if it could be proved that by some local chemical reaction conditions in the bone were made more favorable for calcium phosphate precipitation. This Kay and Robison,<sup>5</sup> in England, believe they have demonstrated. They have secured from ossification centers of growing bone extracts which break down certain organic phosphorus compounds with the formation of inorganic phosphate. You can see that this would cause the local accumulation of an unusual amount of phosphate, the product of calcium and phosphate would exceed the solubility product and calcium phosphate would be precipitated. Although these experiments are not conclusive and require confirmation, they afford a plausible explanation for bone formation and indicate the type of reaction that may prove to be responsible for calcification processes.

Before proceeding to a discussion of the absorption and excretion of calcium and the influences which favor and those which retard calcification, I should like to emphasize again the fact that calcium and phosphate are mutually dependent. Bone cannot be laid down from calcium alone. Deficiency of either calcium or phosphate interferes with or retards calcification. Furthermore, in the serum, because it is a saturated solution, concentrations of calcium and phosphate are more or less reciprocally related. Binger<sup>6</sup> was the first to demonstrate that administration of sufficient phosphate salts to increase phosphate in the serum causes serum calcium to fall and may, thereby, induce tetany. Since then the reciprocal relations between the two ions has been repeatedly demonstrated. It follows that one may have

normal serum calcium with deficient calcification if phosphate is greatly diminished, and normal calcification with deficient serum calcium if phosphate is greatly elevated. The first condition is the one usually encountered in the active stages of rickets, the second is not uncommonly observed in healing rickets.

Thus far the internal environment has been considered as an isolated system. However, it is not independent of the external world. In the first place calcium and phosphate excretion do not cease when the supply is cut off. The organism is, in this case, forced to subsist upon its own internal repositories, the bones, as a source of calcium. There is a certain amount of phosphorus outside of the bones on which the body may call in case of need. This is found in organic combination in proteins, lecithin and other phospholipids, and in organic phosphoric acid esters, all of which occur as structural units of protoplasm. This, Shohl<sup>7</sup> has shown, probably explains the mysterious healing of rickets that is brought about in animals by starvation. However, such endogenous phosphate stores become available for calcification only at the expense of other important structures of the body; and there are no such endogenous calcium stores.

Figure 1, representing schematically the metabolism of calcium and the influences which affect normal calcification or calcium deposits, may aid some in an understanding of the subsequent discussion.

The absorption, from the alimentary tract, of calcium and phosphorus depends first of all, of course, upon the adequacy of the supply of these materials, secondly upon their solubility. Insoluble material cannot be absorbed from the gut. The main determinants of solubility are the reaction of the alimentary contents and the quantities of fatty acids unabsorbed. Alkalinization diminishes the absorption of calcium by causing the formation of insoluble calcium carbonate and phosphate. Acid promotes absorption of calcium by forming more soluble acid salts. It

is for this reason that calcium carbonate is so much less efficient than calcium chloride as a means of conveying calcium

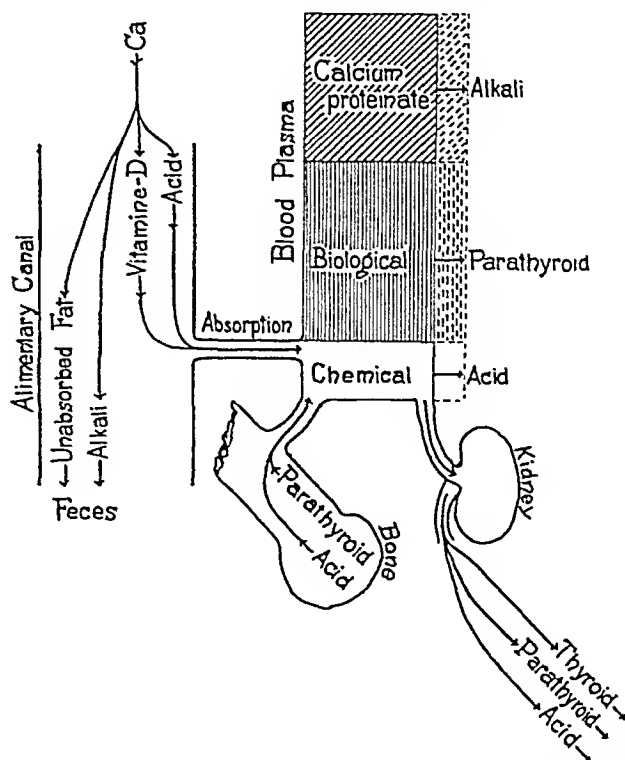


FIG. 1. A schematic representation of the chief factors that affect normal calcification or calcium deposits.

The tube on the left represents the alimentary canal, which is connected with the right-hand column, the blood serum, by a passage marked "absorption." The serum column, surrounded and subdivided by solid lines, shows the relative proportions in which the three types of calcium are found in normal serum. The extensions of this column to the right, surrounded and subdivided by broken lines, represent increases of one or other calcium fraction which may be brought about by influences which increase the solubility of these calcium fractions. The chief influences of this kind which affect each fraction are named opposite arrows, which also indicate the direction of their action. Below are seen outlets to the bones and, through the kidneys, to the urine. The factors which influence absorption and excretion of calcium and its deposition in the bones are represented by the named arrows.

into the body. By the same token gastric achlorhydria may interfere with calcification. Calcium soaps, salts of fatty acids, are extremely insoluble. Therefore, failure to absorb fat from the intestine is attended by improper calcium absorption. So serious may this become that a condition resembling osteomalacia has been known to develop as the result of long-standing fatty diarrhea.

There is one more factor concerned with the intentional absorption of calcium which gains its effects by a mechanism that is still obscure. This is the antirachitic vitamin D, by which I mean the active principle of cod liver oil, ergosterol, activated by ultraviolet irradiation. The primary and perhaps sole effect of this vitamin appears to be to increase calcium and phosphorus absorption from the alimentary tract. Zucker<sup>8</sup> suggested that it gained its effects chiefly by rendering the contents of the gut more acid, but recent work of Shohl<sup>9</sup> and others has made this theory untenable, without offering an alternative explanation for the effect of vitamin D on calcium absorption.

Increasing the absorption of calcium and phosphorus, other things being equal, will promote calcification. Therefore, an adequate supply of vitamin D, normal fat absorption and the maintenance of a relatively acid reaction in the alimentary contents may be looked upon as calcifying procedures, provided adequate amounts of calcium and phosphorus are given in the diet.

If the blood-bone system is considered as a unit, the direction of the flow of calcium salts is found to depend upon the supply of calcium and phosphorus and the solubility of these salts in the serum. The factors which chiefly affect solubility are acid, alkali and the parathyroid hormone. Acid, in the serum as in the stools, increases the solubility of calcium, affecting what I have called the chemically dissolved fraction. Therefore, acidifying measures will tend to decalcify bone. It is on this basis that ammonium chloride is used in the treatment of lead poisoning to promote the elimination of lead from the bones. (We have had under observation for some time, in our clinic, a girl who has, by means of a persistent nephritic acidosis, developed a condition resembling osteomalacia.) Alkalinization, on the other hand, diminishes the solubility of calcium salts and, therefore, tends to conserve bone. It is evident that acid, one

of the factors which promotes absorption from the gut and thus favors calcification, tends to defeat itself by increasing the solution of calcium salts from bone. Which of these effects will predominate must depend on their relative magnitude. If the supply of calcium is made large enough acidification is an efficient means of promoting calcification and has been employed to advantage in the treatment of rickets.

The other chief factor which appears to influence the solubility of calcium phosphate in the serum is the parathyroid hormone, which affects the biologically soluble fraction. Hyperparathyroidism or parathyroid extract increases the concentration of calcium in the serum by dissolving calcium from bone. Every few months adds one or more to the recognized cases with this condition. The symptom complex has been clearly defined. It consists of: increased calcium in the serum with diminished phosphate; excessive excretion of calcium and phosphorus; osteoporosis, sometimes with multiple cystic tumors of the bones; muscular weakness and hypotonia.

Hypoparathyroidism has the opposite effect: diminution of the serum calcium with increase of phosphate; lessened excretion of calcium and phosphorus; muscular irritability and tetany. Thickening of bone may not result because of inability to eat and to thus maintain an adequate supply of calcium and phosphorus. The symptom complex, tetany, seems to be referable specifically to the low serum calcium concentration.

There is some evidence of an uncertain nature that vitamin D may have a direct effect on the maintenance of the level of calcium and phosphorus in the serum. By the administration of excessive doses of irradiated ergosterol serum calcium may be pushed up to extremely high levels. However, unlike that of hyperparathyroidism, the hypercalcemia due to vitamin D is not associated with decalcification; but with augmented calcification, which may even affect tissues other than bone.

Finally one must look to the kidneys as a channel for wastage of calcium. The excretion of calcium is not independent of the level of calcium in the serum and is increased by factors that tend to raise the serum calcium. Chief of these are, of course, acidification and the parathyroid hormone.

One other factor must also be recognized in this connection, thyroxin or the thyroid hormone. Aub has shown that patients with hyperthyroidism waste calcium and, consequently develop demonstrable rarefaction of the bones. Thyroxin has the same effect, while hypothyroidism, whether spontaneous or induced, is attended by retention of calcium and phosphorus and increased deposition of calcium salts in bone.

Theoretically the possibility of conditions in which there is disturbance of calcification due to some inherent defect in the biological factor in bone itself, must be recognized. If Kay and Robison's theory should prove correct one would think of this as excessive or deficient activity of the phosphoesterase. No definite proof of the existence of such conditions has, however, as yet been adduced. Shipley found that *in vitro* calcification proceeded normally in rachitic bone suspended in normal serum, but was defective in normal bone suspended in rachitic serum. The deficiency in this case lies in the medium, not in the bone.

In summary one may state that the problem of normal calcification can be correlated closely with the concentrations and solubilities of calcium phosphate in biological media, although it is still impossible to formulate a quantitative statement of these correlations in simple mass law equations that will satisfy the chemist. At least three fundamental factors in calcification can still be described only indefinitely as vital properties, although the present intensive investigation of the problem bids fair to throw some light on the nature of these properties. These three factors are: 1. the power of vitamin D to

further alimentary absorption of calcium phosphate; 2. the factors, of which parathyroid is one, which permit serum and other body fluids to hold in solution such a high concentration of calcium; 3. the factor which depresses solubility, thereby producing precipitation, in regions of normal calcification.

Calcification cannot be correlated with the levels of calcium in the serum. One fraction of the serum calcium, which depends on the protein content of the serum, apparently plays no part in calcification. Even the non-protein active calcium is not in itself a criterion of calcification; this depends on the product of calcium and inorganic phosphorus. These two elements, other things being equal, vary reciprocally. Of the active calcium two fractions can be recognized, the chemically soluble and the biologically soluble calcium. Anything which increases the solubility of active calcium in the serum tends to dissolve calcium from the bones. The chief decalcifying measures of this class are acidification, which affects the chemically soluble fraction, and excess of the parathyroid hormone, which affects biological solubility. Osteoporosis has been recognized as the result of hyperparathyroidism and, in at least one case, apparently as the result of long-standing acidosis.

The bones are used as a store of available calcium and phosphorus when the exogenous supply is deficient. Therefore, proper calcification depends on the provision of an adequate supply of both calcium and phosphorus and the maintenance of favorable conditions for their absorption in the alimentary canal. Such favorable conditions are efficient digestion and absorption of fat, the maintenance of a relatively acid medium and the presence of a sufficient supply of both components of vitamin D, ergosterol and ultraviolet light. Rickets and true osteomalacia both appear to be deficiency diseases due to insufficient supply of calcium and phosphorus.

Finally decalcification may occur in the

face of an otherwise sufficient supply of calcium and phosphorus if urinary excretion of these substances is greatly accelerated. The chief factors which cause accelerated urinary elimination are acidification and the internal secretion of the thyroid gland.

The state of the process of calcification at any one time will be a resultant of the effects of all these individual factors; and only by the application of discriminating judgment to the analysis of an individual case can diagnosis and therapy be intelligently directed.

#### DISCUSSION

DR. FREDERIC W. BANCROFT: I have been interested in the cellular side of bone repair. As you know, it is easy to produce extraskeletal bone experimentally. If one ligates the renal vessel and wraps omentum about the kidney, at the end of a month bone and calcification are seen in the parenchyma of the kidney. Bone occurs where there are living cells and calcification in the necrotic areas. The mineral ash of calcification and ossification is the same. You may scrape the aorta of the rabbit and paint it with silver nitrate, and bone will occur in the adventitia. It occurs in the bite of the ligature. Pathologically bone occurs in almost every organ of the body. Neuhoof, in experimenting with fascia lata transplants to fill a defect in the bladder, found that bone almost universally occurred in the fascia lata transplants. Obviously if one is to produce a theory of bone formation it must account for extraskeletal, experimental, and pathological bone, as well as for skeletal bone. If one studies the microscopic sections of bone repair following fractures, and such sections are studied from three days after the injury until two or three weeks, it will be seen that following trauma hemorrhage occurs; then one sees wandering fibroblasts and beginning organization of connective tissue. About four days following the fracture beginning ossification is seen in the avascular areas of the newly-formed granulation tissue. One sees a blood vessel, and, surrounding this, areolar tissue and at the periphery new bone. This ossification does not appear microscopically to be a result of the secretory phenomena of a specific cell: it appears as if the wandering connective tissue

cells were caught in a deposit of calcium salts. This appearance compares very well with Dr. Peters' suggestion that the calcium salts are deposited due to some change in the hydrogen ion content. I am glad to know Dr. Peters stresses the fact that the calcium in the skeleton is in a state of flux and may be drawn from the body in case of emergency. Much harm has been done by our conception of bone as the hardened inert mass one sees hanging up in the laboratory as a prepared skeleton. Bone is a living structure and is constantly changing, not only in shape but in concentration, to meet the daily demands of the human organism.

DR. R. F. LOEB: From what Dr. Peters said, it is clear that great strides have been made in our understanding of the problem of normal calcification, but it is also apparent that we have not yet reached the end of the problem. From the point of view of the local conditions in the tissues, it is apparent that we are just beginning to scratch the surface of a very difficult investigative task. Like Dr. Bancroft, I am neither a chemist nor a physiologist and do not wish to enter upon the question of the local mechanisms existing within the bone which are important in calcification; I do, however, wish to emphasize what Dr. Peters has said, perhaps expressing it as the evaluation of the problem of calcification in a given patient. Dr. Peters has emphasized the fact that the blood calcium determination in itself is of little value. First of all this is true because in the presence of a high blood calcium we have no way of knowing from this determination alone whether calcium is going to or coming from the bone. Hence any attempt to judge a process of calcification from that point of view alone is ridiculous. In some cases the relationship of active calcium and of phosphorus may be adequate in the blood in the presence of a low calcium concentration, this being true, as Dr. Peters has pointed out, when the protein content of the serum is low. In spite of the proper consideration of the protein calcium and the protein calcification in the serum, Dr. Peters has pointed out that decalcification or abnormally great calcification may be proceeding. This point has been made clear from the studies of Aub and Bauer in their work on hyperthyroidism in which decalcification may be marked and yet blood concentration of the factors involved in calcification may be normal.



From the clinician's point of view the time is certainly coming when our being satisfied with such vague terms as osteoporosis or osteomalacia may no longer satisfy us and we must begin to consider these conditions from the point of view of the factors from which they develop. For instance, as Dr. Peters has pointed out, in thyroid disease with normal levels of calcium and phosphorus in the blood we have an increased loss of calcium through the kidneys, perhaps as a result of a lowered threshold. On a very acid diet decalcification is brought about again by increasing solubilities of calcium phosphate in the blood, and in certain cases of faulty fat absorption from the intestine rarefaction of bone may result from inadequate absorption of calcium. Hence in any case of abnormal calcification it seems important that an accurate study of the relation of calcium intake and output should be made.

Finally, I should like to emphasize the danger of the promiscuous use of two new weapons introduced into clinicians' hands for the so-called treatment of osteoporosis, or delayed bone union. Parathyroid extract for a time was used in the treatment of some of these conditions, but we now know that its employment is absolutely contraindicated as the increased calcium in the blood resulting from injections of this hormone is derived from bone and is in no way related to increased laying down of the bone. With irradiated ergosterol we have a similar situation; it appears to increase absorption of calcium and phosphorus from the intestine, thereby increasing the concentration of calcium in the blood and increasing calcification of the bone. However, after exceeding a certain level in the dosage of ergosterol, calcification is no longer increased, but actually decalcification begins, also with an elevated calcium concentration of the blood, as has been shown recently by Shohl and others. It might be well for the time being to study the calcium balance in those cases in which irradiated ergosterol is being used to promote calcification.

DR. CLAY RAY MURRAY: My interest in this subject lies in its application, if any, to the question of delayed or non-union in fractures, in the bearing which the biochemistry of the blood serum has on fracture healing.

As clinicians, we all know that if a patient comes to us with a fractured neck of the femur, intracapsular, we immediately

begin to wonder whether that fracture will show bony union, fibrous union, or actual absorption of the neck of the femur. If a patient comes in with an intertrochanteric fracture, an inch and a half further down the bone, we are so sure of bony union that it has become a byword that this latter type of fracture heals by bony union *despite* treatment. This viewpoint, based on empirical clinical findings, holds regardless of the age of the patient, his metabolic state, his general health, specific disease, or any other clinical factors. Again, if a patient shows a fracture of the tibia, at the junction of the lower and middle thirds, one counts on a slow union, with a chance of non-union. The same is true of fractures in the lower portion of the middle third of the humerus. I remember a patient who fell from a building and sustained a double fracture of both tibiae, one at the juncture of the upper and middle thirds and one at the juncture of the lower and middle thirds in each leg. Both legs were treated identically by pin traction, with excellent rapid reduction, and early physiotherapy. The upper fracture in each leg healed by bony union in average time; the lower fracture on one side developed a delayed union requiring nineteen weeks for bony healing, and on the other side the lower fracture resulted in a non-union requiring operation.

Actually, clinical observation leads to the conclusion that delayed and non-union, when fracture treatment is competent, is a problem of the fracture site, and not of the individual involved. At certain sites one frequently sees delayed and non-union under the best of treatment. At other sites, one never sees it under proper treatment.

Clinically also, the very cases which show a generalized calcium and phosphorus metabolic disturbance show a normal fracture healing, except when the places involved are the very sites which show delayed and non-union in the metabolically normal individual. Particularly, I cite rickets and osteomalacia cases. They heal their fractures normally. At the Presbyterian Hospital we now have a patient with osteomalacia who has had a low serum calcium, a serum phosphorus as low as 1.2, and under careful and prolonged metabolic study a negative calcium balance. She sustained a pathological fracture of the lower femur, which shows by x-rays a solid bony healing with no delay in time.

Another case of clinical interest from this



viewpoint, and this situation is frequently found, is that of a patient having a fractured neck of the femur recently seen at the Presbyterian Hospital, in whom the neck of the femur absorbed practically completely within eight weeks, and *simultaneously* there was going on *extensive* calcification of the joint capsule.

Again, I have never been able to observe any clinical effect on delayed or non-union from the administration of medications designed to correct possible defects in calcium and phosphorus metabolism. I have utilized and observed the effects of calcium by mouth, cod liver oil, thyroid, parathyroid hormone, mercury quartz vapor light, irradiated ergosterol, and the various vitamin foods. In no cases has there been clinical evidence of any effect. The blood phosphorus and calcium has been recorded in these cases, though it must be acknowledged that without accurate control of balances they mean little if anything. The blood findings have no relation to the occurrence of delayed or non-union.

These varied findings have made me feel for some time that the story of delayed and non-union in fractures was a purely local one, that the biochemical changes which occurred, resulting in the deposition of calcium, were local in the tissue fluids, and not dependent on the amount or state of the calcium or phosphorus in the blood serum. In an experimental series, mention of which has been made in the literature and the full data of which is shortly to be published, a  $2\frac{1}{2}$  cm. piece of dog's radius was resected with its periosteum, creating a  $2\frac{1}{2}$  in. gap in the bone. If the resected piece were cut into small chips and dropped back in the gap, solid bony filling of the gap would occur. If the fragments were first boiled, destroying their vitality, solid bony union would occur just the same. If they were first decalcified, no bony union would occur. If the fragments were discarded and the gap left empty, no bony union would occur. But if the fragments were discarded and the gap filled with calcium carbonate and calcium triple phosphate, or with calcium carbonate and calcium phosphate, *bony union* would occur. In this series of animals, under the given conditions, certainly the occurrence of bony union depended on the presence or absence *locally* of calcium, regardless of the chemistry of blood serum. All these animals were on the same diet,

and apparently normal, giving no evidence of metabolic disturbances. All were adult animals. The bone chips as a local calcium source in fractures are represented by the bone killed by the fracturing violence and pathology. The autolysis and demineralization of this bone can be clearly demonstrated, as can the fact that the tissues about a fracture site contain a really tremendous calcium concentration.

I am convinced by both chemical evidence and the experimental findings in toto in this field, that the ossification of a healing fracture is dependent upon local factors at the fracture site, and that even if we grant the exact mechanism of calcium deposition which Dr. Peters describes, the factors in the *blood serum* which he has mentioned have absolutely no bearing on the clinical union or non-union at a given fracture site.

DR. FRED ALBEE: I have published experimental work very similar to what Dr. Peters outlined,<sup>1</sup> with reference to checking up on putting fragments of bone in between the fragments where a section of bone had been removed.

I was induced to carry on the research at that time because of claims published that a new treatment had been discovered for pseudarthrosis in the human subject from experimental work upon animals. It was stated that it was found when a segment of an animal's long bone was resected and chipped with small fragments and placed back in the hiatus it came from, that the bone never failed to unite.

Feeling that an animal's bone will ordinarily unite under most any conditions, early in 1918, with the collaboration of Lieut. H. F. Morrison, I undertook to produce a pseudarthrosis in a rabbit's leg and failed. Segments were resected from various long bones and put back whole, in different sized pieces; no bone was put back at all; the animals' limbs were exposed to heavy doses of x-ray; they were carefully splinted, and no splints were supplied whatsoever, but we did not succeed in producing one pseudarthrosis. Every bone united.

Solutions of triple phosphates were also injected into the region of the callus of a broken rabbit's bones. A comparative x-ray study of these results and controls led to the conclusion that increased callus formation had been stimulated.

When, however, the same solution was

<sup>1</sup> *Am. J. M. Sc.*, 1928; *Ann. Surg.*

injected into cases of true clinical pseudarthrosis, no benefits were derived whatsoever. In a few cases the tissue infiltrated broke down, and the case was then still further complicated.

I therefore wish to emphasize the fact that deduction based upon observations in relation to fresh fractures in animals, or in the clinic, must be applied with the greatest caution and conservatism to the problem of the treatment of pseudarthrosis.

It is very difficult to draw conclusions from such a discussion as that presented by Dr. Peters, when it is applied to actual clinical cases, but I have been very much interested and enlightened by it.

DR. PETERS, *closing*: My paper was limited to normal calcification, a subject that has been studied objectively and quantitatively. As far as I know the subject of healing fractures has not been studied objectively and quantitatively in the same sense.

Some experiments are now being made in another department than my own at Yale, on the healing of fractures in animals, which indicate that metabolic factors have a distinct influence upon fracture repair; that one can demonstrate quantitatively the effect of factors that affect absorption, deposition and excretion of calcium. The experiments which Dr. Murray presented do not seem to show careful consideration of such general factors. Undoubtedly local factors do have an influence. Kay and Robinson have suggested as an explanation for this influence the activity of phosphoesterases which, by converting organic to inorganic phosphates, increase the solubility product and therefore promote precipitation of calcium phosphate. The existence of such phosphoesterases not only in bone, but also in other tissues, has been demonstrated not only by Kay and Robinson, but by investigators in Meyerhoff's laboratories. It is rather interesting that a phosphoesterase almost indistinguishable from that of bone has been demonstrated in the kidney. Calcium deposition may occur in other tissues than bone, especially when they have been subjected to injury. The kidney seems peculiarly susceptible. But the factors

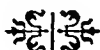
that promote such deposition have not been studied objectively or quantitatively.

There is some work on record to show that healing does go on even in the absence of exogenous supplies of material; it proceeds at the expense of other tissues in the body. I object to the idea that ham and eggs can be made without either ham or eggs. Undoubtedly healing in rachitic bone will occur. These are quantitative matters. In rickets people do not go without bone; the deposition is only retarded. The injured animal in some respects seems to act like the growing animal, favored by distinct conservative processes. This can be illustrated by an example from nitrogen metabolism, a subject in which I am especially interested. If a person becomes mal-nourished, conservative processes are immediately instituted by the organism as if for self-preservation. These mitigate malnutrition and promote repair. When a part is injured some especial attention seems to be given to that part and all the conservative powers of the body are enlisted in its favor.

The fact that local factors influence calcification is a reason why they should be studied, but it is no reason for denying the influence of general factors which, I believe, are demonstrably active.

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# ELECTROSURGERY AS A HEMOSTATIC INSTRUMENT IN OPERATIONS UPON THE LIVER, KIDNEY AND SPLEEN\*

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THE full use of electrosurgery has not been realized. The experience of Clark,<sup>1</sup> Wyeth,<sup>6</sup> Kelly,<sup>2</sup> and others has demonstrated that this device is a valuable adjunct in the eradication of malignant disease. Electrosurgery has proved its worth in dealing with carcinoma, but it is considered that there are other uses for these currents that have not been adequately investigated. After reading a very graphic account by Keen of the difficulty of controlling hemorrhage in operations upon the liver, it was decided that electrosurgery might be used with profit on vascular, parenchymatous organs. Experiments conducted on the liver, kidneys and spleen showed that extensive operative procedures can be carried out with only moderate primary bleeding, no secondary hemorrhage and good repair.

The results of these experiments were presented before the American College of Physical Therapy in Chicago, November, 1927, and were mentioned in the discussion of a paper by Dr. H. A. Kelly<sup>25</sup> but were never published. In the following year the study on the kidney was amplified by G. E. Ward and W. W. Scott and the results confirmed. The operative procedures were more extensive in these experiments and two instances of secondary hemorrhage were recorded, apparently following infection.

Subsequently, McLean<sup>3</sup> described the healing of electrosurgical wounds, and Scott<sup>4</sup> reported on the advantage of the clinical use of the current on the kidney. We have used it clinically on the liver for biopsy, resecting tumor nodules and opening cysts, and dissecting the gall-bladder from the liver.

Since the data obtained from the original

experiments influenced to some extent what has subsequently been done in the field, it was considered advisable to place them on record.

## METHODS

Dogs were used as the experimental animals. All operative procedures were conducted under ether anesthesia after preliminary medication of morphia,  $\frac{1}{4}$  grain. Strict surgical asepsis was observed and the animals allowed to survive.

*Operations on the Kidney.* The procedure consisted in excising a wedge-shaped elliptical segment, about 8 mm. wide and from 4 to 5 cm. long, from the cortex of the kidney, the apex of the wedge extending down into the pelvis. This is shown by Figure 1. The defect was closed in the usual manner by Halsted mattress sutures of silk. Since one object of the investigation was to determine the amount of primary bleeding, no clamp was placed on the pedicle vessels. In this manner one kidney was operated on electrosurgically and the other with a scalpel, giving comparison of the two instruments in the same animal. Bilateral nephrotomy through a midline abdominal incision is possible in the dog as the kidneys are movable and can readily be delivered. The animals were sacrificed at intervals and the appearance of the organs noted and photographed. As an additional control, histological specimens were taken from the scar in the two kidneys. A rough estimate of the hemorrhage from each kidney was made by counting the number of sponges soiled with blood. Twelve dogs were so operated upon and sacrificed at intervals of from twenty-four hours to eight weeks.

Other kidney experiments were carried

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out on a few more animals. A broad, disc-shaped portion of the cortex,  $2 \times 4$  cm. in size, was removed with the current and the

procedures done with the scalpel since excessive hemorrhage would result from the cut surface.

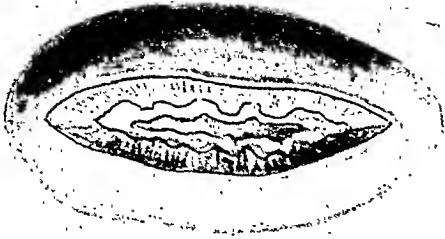


FIG. 1. Kidney, after removal of elliptical wedge shaped segment down to pelvis.

kidney replaced without suture. In other animals, formaldehyde solution was applied to the coagulated surface to determine its effect upon secondary hemorrhage. Finally an entire pole or half the kidney



FIG. 4. A comparison of wounds made by electrosurgery and scalpel in kidney (twenty-four hours after operation).



FIG. 2. A portion of liver lobe resected without hemorrhage by electrosurgery.



FIG. 3. Pole of spleen removed with tonsil snare and diathermy. Note excessive coagulation.

was removed with a tonsil snare carrying the current, and the kidney was replaced without suture or packing. These experiments could not be compared with similar



FIG. 5. External scar resulting after operations on kidneys with knife and electrosurgery (eight weeks postoperative).

*Operations on the Liver and Spleen.* In order to test the efficiency of the electrosurgical "knife" in controlling hemorrhage from incisions in the liver a portion of its lobes were resected. The liver was exposed, traction made upon a lobe and a portion excised (Fig. 2). The procedure was repeated on one or two lobes and the liver replaced in the abdomen. No packing or suture was necessary. Occasionally slight bleeding from the central artery occurred which was quickly controlled by coagulation after clamping, according to the method of Ward.<sup>3</sup>

In a similar manner the end of the spleen was excised. The incision with the current

was begun just external to the vessels of the hilum and carried through the organ resecting the lower pole. The same portion

capable of cutting and coagulating has a greater range of current than a cautery has variation in temperature. Consequently,

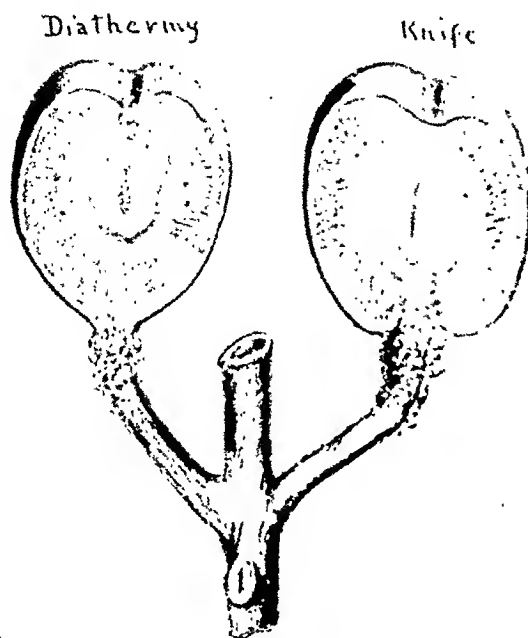


FIG. 6. Scar in kidney substance (three weeks after operation).

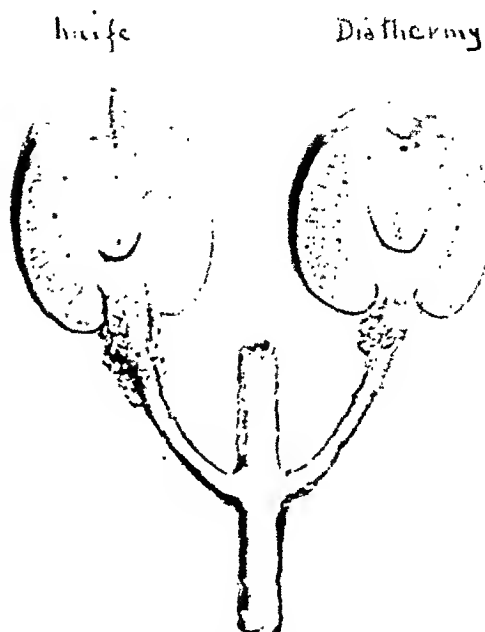


FIG. 7. End-result. Scars seven weeks postoperative showing complete repair.

of the spleen was removed with a tonsil snare through which the current was passed. (Fig. 3.)

In the experiments on the liver and spleen a comparison between the results with electrosurgery and with the scalpel could not be made because of hemorrhage following the operations if performed with a knife.

**Current.** For the incision through the skin, muscle and fascia the damped current should be smooth (very small spark-gap, consequently low voltage) and have a high amperage and high frequency. The current was considerably modified during the course of the investigation, the primary requisite being to control hemorrhage while cutting without too destructive coagulation. A current was developed which had the properties of coagulation and cutting, being of very high amperage (small spark-gap) and high frequency much of stronger amperage than used in the abdominal incision. It must be borne in mind that an electrosurgical apparatus

if a cutting current, such as is used for ordinary dissection, is used upon parenchymatous organs, about as much bleeding is encountered as if a scalpel were employed. This matter of control of current is so important and the variation in different machines so great that further investigation must be done to develop an apparatus which will deliver more uniformly this combined cutting and coagulating current.

#### RESULTS

The control of hemorrhage at the time of the operation is the important feature of electrosurgery. It was found that this is equally true of operations on the liver, kidney and spleen. In the experiments on the kidney no clamp was placed on the pedicle yet the removal of an elliptical segment from the cortex to the pelvis caused only moderate bleeding. The bleeding usually came from the larger arteries deep in the kidney substance, and these occasionally required clamping and coagulation. Thus it was that dissection and

suture could be carried out with deliberation in a dry field and a more accurate incision and apposition of the cut edges

weeks, shown in Figure 7, illustrates how successful is the reparative process after using a high frequency surgical current.

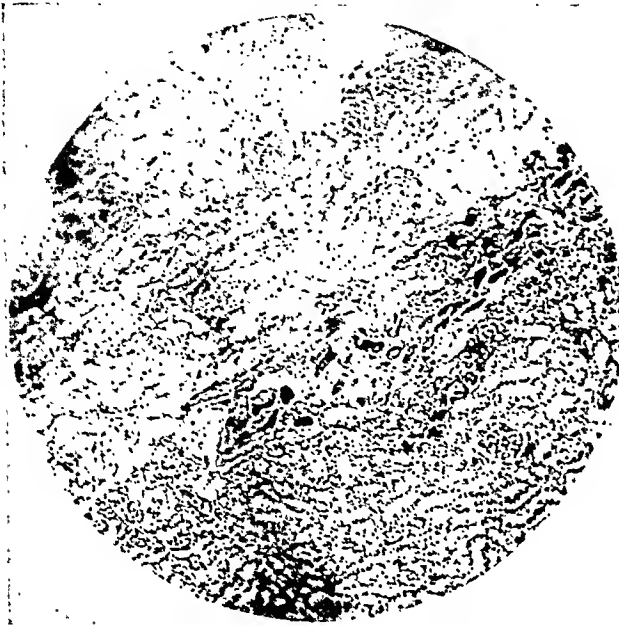


FIG. 8. Zone of hyalin degeneration eighteen days after coagulation.

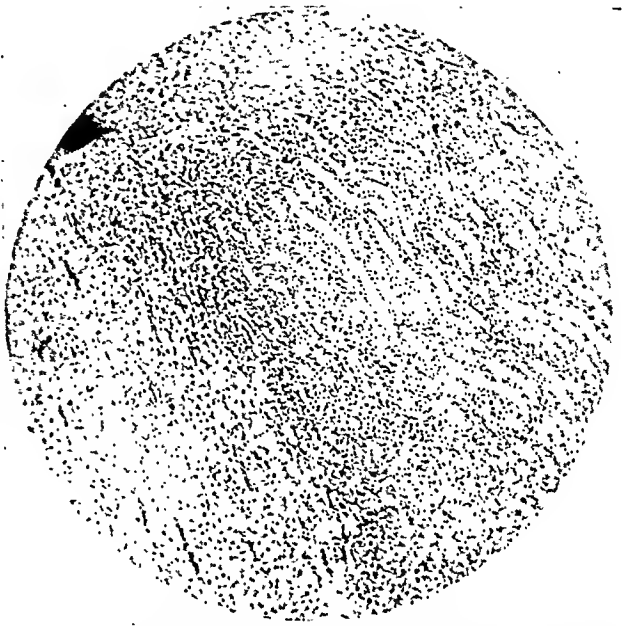


FIG. 9. Repair eight weeks after operation with electrosurgery. Hyalinized material has been replaced by fibrosis.

obtained. The blood lost during this procedure soiled an average of four sponges. This was in marked contrast to the same operation done with the scalpel where the bleeding was profuse and an average of fourteen sponges used. Here speed was necessary to remove the segment and suture the edges before the animal became exsanguinated. Of course, in most operations it is possible to clamp the pedicle but even if this cannot be done electrosurgery will partially control the bleeding.

The repair of the kidney after electrosurgical incision is not dissimilar from that after the scalpel. The scar is broader because of the zone of coagulation at the cut edges. This may be seen in Figure 4 which illustrates the condition twenty-four hours after operation and in Figure 5 showing the appearance eight weeks later. Observation of a cross section of both kidneys from the same animal shows that just as the surface scar is broader so the scar deep in the tissue is more prominent. This is well shown by Figure 6. However, after contraction of the scar the difference is less marked and the result after seven

Microscopic examination of these specimens shows a slight area of carbonization at the periphery with a zone of coagulation beneath consisting of degenerated nuclei scattered through a mass of homogeneous hyalin material, during the process of repair, the coagulated tissue having become uniformly hyalinized. In the zone next the normal tissue are to be found round cells and fibroblasts. This stage is shown by Figure 8. Later the hyalinized material is reabsorbed and replaced, by fibroblastic proliferation and infiltration giving rise to a firm cicatrix, as shown in Figure 9.

In contrast to this sequence of events, healing after scalpel incision occurs with less hyalinization and less round cell infiltration. There being no zone of coagulation, the clot and fibrin are reabsorbed and replaced by connective tissue. The lower tip of such a scar is shown by Figure 10 where it is evident that the reparative reaction is less extensive than in the preceding specimens.

In the removal of a large disc-shaped area from the cortex of the kidney without

subsequent suture little bleeding was encountered. It is probably that, since the incision did not go as deep as that

When the entire pole was resected with a tonsil snare carrying the current no bleeding occurred. By this method, greater



FIG. 10. Scar eighteen days after operation with scalpel. Only lower tip of scar is shown.

previously described the larger arteries were not cut and hence the hemorrhage



FIG. 11. Healing sixteen days after removal of large segment of cortex with electrosurgery without suture. Note size of scar and small unhealed central area.

more readily controlled. In spite of the fact that there was no attempt to repair the defect in the kidney by suture, the healing is satisfactory. In Figure 11, the outline of the smooth scar may be seen with a small unhealed area in its center.



FIG. 12. Three weeks after resection of one-half of kidney with electrosurgical tonsil snare.

coagulation was obtained which, though it seemed to prevent hemorrhage, was not desirable on account of the excessive destruction of the tissue. The end result shows (Fig. 12) preservation of less healthy, functioning tissue than if the pole had been resected by a strong cutting current in place of the snare.

The removal of a portion of one or more



FIG. 13. Repair of the spleen two weeks after resection of one pole with electrosurgery.

lobes of the liver with the cutting current is one of the most spectacular procedures in surgery. The former methods of controlling hemorrhage from the liver by suture with special needles, by the actual cautery, or by packing with gauze, omentum or muscle are often ineffective and the surgeon is helpless to stop the persistent bleeding. On the other hand with electro-surgery large portions of the liver may be removed, without bleeding. Occasionally there is



slight bleeding from the central artery but this is quickly controlled and at no time was more than one sponge soiled with blood.

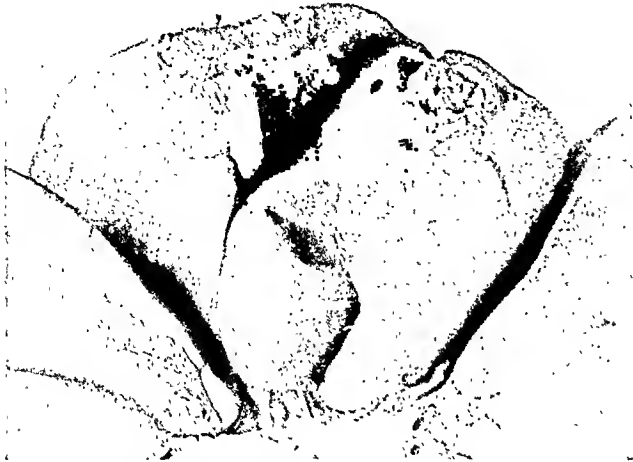


FIG. 14. Healing of liver three weeks after removal of portion of two lobes with electrosurgery. No suture of cut edges.

The spleen, on the other hand, is a much less favorable organ to attack with the current. Here the large number and size of the arteries cause the difficulty. These arteries are cut through without being coagulated and arterial hemorrhage is prominent. Because of the softness of the splenic pulp the vessels are difficult to grasp with a clamp, heavy coagulation being necessary to control the bleeding. Almost complete hemostasis is obtained, by resecting a pole with a tonsil snare through which the current is passed but here, as in the kidney, excessive coagulation and destruction of tissue occurs.

In the spleen and liver there is a similar type of repair to that occurring in the kidney. An extensive coagulated area was left exposed which was protected only by covering with omentum. Consequently, repair by fibrosis must result. That this occurs satisfactorily is shown by Figures 13 and 14, where a firm cicatrix is seen covering the defect in these organs. Histological examination of these specimens bears out the similarity of the process of repair to that in the kidney. Figure 15 illustrates the zone of carbonization separated from the healthy tissue by a zone of coagulated, hyalinized debris.

There remains to be mentioned the healing of the incision through skin, muscle and fascia. In every case repair was by

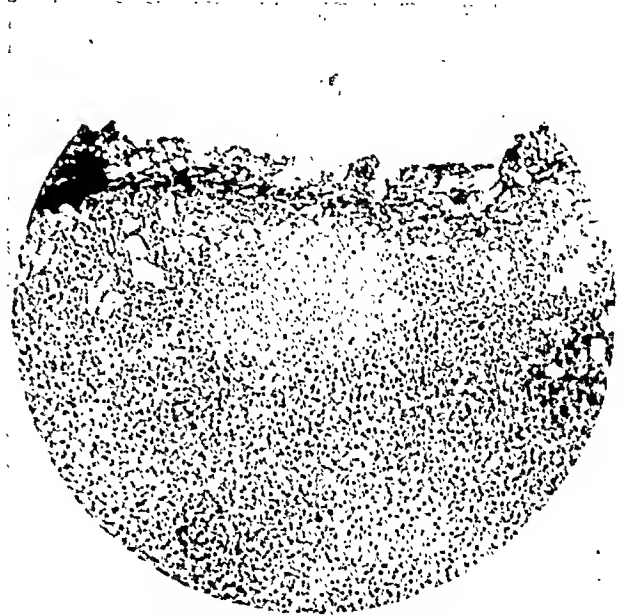


FIG. 15. Effect of current on liver tissue. Zone of carbonization and of coagulation are illustrated.

primary union and in no instance was a better result obtained by the use of the scalpel. In those instances, where half the incision was made with each instrument, it could not be determined where one left off and the other began. Of course, the current for the abdominal incision was much weaker than that used in the parenchymatous organs giving a slight zone of coagulation (0.1 to 0.2 mm.).

It is to be expected from previous knowledge of the subject that with the electrosurgical cutting current primary bleeding will be less than with the scalpel. Past experience has also shown that secondary hemorrhage is a frequent complication of electrosurgical operations in the mouth and other infected areas if preliminary ligations of large vessels has not been done. In twenty animals, each of which had two or more organs operated upon, no instance of secondary hemorrhage resulted. Hence, it is seen that if asepsis is observed secondary hemorrhage is abolished.

#### DISCUSSION

The application of these experiments



to clinical surgery is self evident. The trend of modern methods is to conserve healthy tissue wherever possible. In consequence, nephrotomy, heminephrectomy, nephrolithotomy and plastic operations for hydronephrosis and pyonephrosis are replacing nephrectomy in many cases. These operations necessitate cutting into the kidney substance and are usually bloody, despite all precautions. If the same operation may be accomplished by electrosurgery with less hemorrhage and consequent greater deliberation and accuracy of procedure, then the technic is desirable. Further, it has been shown that large areas of the cortex or even half the kidney may be removed without serious hemorrhage and that good repair results without suture of the edges. Other methods demand suture for hemostasis and if it can not be done nephrectomy is necessary.

The presence, in the liver, of localized pyogenic or amebic abscesses, echinococcus cysts, primary or metastatic tumor nodules give indications for surgical interference. Elaborate methods have been devised to secure hemostasis in the liver. Packing with gauze, rubber tissue, omentum or muscle, the use of the thermocautery, special needles and methods of suture, elastic ligatures, plates of magnesium, cartilage and decalcified bone have all been tried and found unsatisfactory in some particulars. Following the electrosurgical resection of a part of the liver lobe the liver was purposely replaced without suture. Less scarring would result if the cut edges had been approximated but it was desired to show that electrosurgery alone was an effective hemostatic agent.

A word of warning about the current used is necessary. There are many different types of electrosurgical current generators and the general term, electrosurgery, is chosen in this paper to cover a number of different high frequency currents: light cutting for the abdominal incision, heavy cutting for the parenchymatous organs and coagulation for large blood vessels. Consequently, if the surgeon is contem-

plating the use of electrosurgery on parenchymatous organs, he should first familiarize himself with his own particular machine and determine if it is capable of developing the desired current. In this regard, it is desirable that further investigations be made: (1) to produce a more rapidly coagulating current where larger arteries are to be encountered; (2) to secure a metal or an active electrode which will not adhere to the coagulated tissue. These experiments have demonstrated that electrosurgery offers a hemostatic cutting agent for use in the parenchymatous organs in dogs. The absence of secondary hemorrhage and the satisfactory repair following its use warrant its consideration as a part of the operative technique of vascular structures.

#### CONCLUSIONS

1. Extensive electrosurgical procedures may be performed on vascular organs in dogs such as the liver and kidney with only slight primary bleeding.
2. In the absence of infection, secondary hemorrhage did not occur.
3. Healing was uneventful and though the scarring was unusually more extensive, than the use of the scalpel, the end result was satisfactory.

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# CARCINOMA OF THE ANUS AND RECTUM\*

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## ETIOLOGY

THE *causa causans* of rectal carcinoma is, of course, unknown. Chronic irritation is presumably a factor in the etiology, and obviously the rectum and anus are peculiarly subject to traumatic and chemical irritation.

## PREDISPOSING CAUSES

Amongst predisposing causes tissue predisposition is frequently mentioned. It is asserted that carcinoma develops on the basis of (1) simple benign tumors of the rectum, especially adenomata, and (2) chronic inflammatory conditions of the rectum and anus, such as hemorrhoids, fistulae and anal tags.

Thus, of 37 cases admitted to Baylor hospital, 14 revealed hemorrhoids, 3 previously benign polpi, 2 fistulae, and 1 malignant degeneration in an anal tag.<sup>1</sup>

Many proctologists, notably Lockhart-Mummery, believe the commonest origin is in the simple adenomas which develop from the glands of Lieberkühn.

However, Ewing quotes Kraske with approval as expressing the belief that "There is no satisfactory evidence that cancer develops in tissues altered by hemorrhoids, fistulae, or cicatrices," and expresses himself as being satisfied that the only definite instance of tissue predisposition as a factor in the development of rectal carcinoma occurs in connection with multiple polyposis.

## RELATIVE FREQUENCY OF RECTAL CARCINOMA

Next to the stomach, the rectum is the most frequent site in the gastro-intestinal tract for the development of carcinoma. Hirschman and Rosenblatt state that 50 per cent of all cancers occur in the intestinal tract and that 16 per cent are cancers

of the rectum or sigmoid colon. Of 123 intestinal carcinomas Kaufman (quoted by Ewing) found 51 in the rectum; he is authority for the statement that over 60 per cent of intestinal carcinomas and 5.25 per cent of all carcinomas occur in the rectum; this puts the rectum fifth in the order of frequency of all the sites of primary carcinoma in the body. At the Pathologic Institute of Vienna, 47.2 per cent of all intestinal carcinomata examined between 1870 and 1893 occurred in the rectum (quoted by Ewing). Russell (quoted by Fitchet), basing an estimate on the work of Gant, Ball, and Halstead, estimates that 80 per cent of intestinal cancers involve the rectum. Jones states that 12 per cent of all carcinomata occur in the intestinal tract and that of these 55 per cent occur in the rectum.

## AGE INCIDENCE

The disease is characteristically one of patients past middle life. Murdock states that two-thirds of the cases occur in individuals between forty and sixty years of age. However, the disease is by no means confined to those of advanced years. Steiner<sup>2</sup> reported a case in a boy of nine years. The Allinghams<sup>3</sup> reported a case in a boy thirteen years of age. Phillips<sup>4</sup> collected from the literature all the cases up to 1908. Warthin<sup>5</sup> reported 2 cases in persons under thirty years of age as the result of the study of 2000 specimens. Pennington<sup>6</sup> collected 40 cases of patients under twenty years of age from 7174 reported cases. Fowler<sup>7</sup> quoting statistics from the Mayo Clinic, reported 14 cases in ten years. Clark<sup>8</sup> was able to collect 51 cases from the literature to date, and added one of his own. Loewenberg<sup>9</sup> added 1 case, that of an eighteen year old boy. Spittler<sup>10</sup> reported a case of a patient

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eighteen years of age. Da Costa<sup>11</sup> reported a case in a white male nineteen years of age.

#### SEX INCIDENCE

Males are affected more frequently than females. The ratio between the sexes in some series of cases is as high as two to one.

#### PATHOLOGY

##### MICROSCOPICAL ANATOMY

Carcinomata of the rectum, except for the occasional squamous-cell epithelioma or epidermoid cancer, which occurs at the mucocutaneous junction of the anus and arises from skin epithelium, are adenomatous or glandular in type. Microscopically they range in structure all the way from virtually normal rectal gland formation to an architecture in which almost all traces of gland formation are lost.

Ewing classifies rectal carcinomata in the order of frequency of their occurrence as: (1) adenoma destruens, (2) stenosing fibrocarcinoma, (3) gelatinous adenocarcinoma, (4) bulky polypoid or papillary carcinoma, (5) multiple carcinoma following polyposis (6) acanthoma, and (7) melanoma.

##### GROSS PATHOLOGY

Fitchet states that between 50 and 60 per cent of all rectal carcinomata occur in the region of the midrectum, and Wheeler states that 90 per cent of growths situated in the rectum, rectosigmoid, or lower sigmoid can be palpated by simple rectal or bimanual examination.

According to their gross appearance carcinomata may be classified as (1) papillary, (2) polypoid, (3) mucoid, (4) ulcerating, (5) infiltrating, and (6) "napkin-ring."

Carcinomas of the rectum always tend to infiltrate the wall of the intestine in a circular manner, and relatively rarely to encroach upon the lumen except by concentric stenosis. Clemons states that only 1 out of every 30 lethal carcinomas projects perceptibly into the lumen of the rectum.

#### SYMPTOMS AND SIGNS

The earlier symptoms and signs are often vague, and never pathognomonic. They depend upon (a) ulceration, (b) stenosis, and (c) tumor formation. They consist of: (1) changes in previous bowel habits, especially constipation, and, when present, "morning diarrhea"; (2) a sense of discomfort in the rectum not relieved by defecation; (3) pain, usually noted rather early in anal carcinoma, infrequently and late in the ampullary and rectosigmoid types; (4) bleeding, which may be considerable in amount and consequently overlooked, but "all rectal cancers bleed" (Rosser).

In the intermediate stages the symptoms and signs are similar but more pronounced:

(1) Constipation or alternating constipation and diarrhea.

(2) Increasing local discomfort.

(3) Moderate pain depending especially, as just previously noted, upon the type of carcinoma.

(4) The discharge of blood, either alone or in combination with mucus or pus, and

(5) Moderate loss of weight.

Rankin, reporting the Mayo Clinic statistics, in an unclassified grouping of cases, for the ten year period ending January 1, 1916, which were based on 602 cases of rectal carcinoma, gives the percentage of incidence of the cardinal symptoms as:

(1) Rectal bleeding 89.5 per cent of cases.

(2) Constipation 55 per cent.

(3) Diarrhea 20 per cent.

The classical textbook symptomatology of rectal carcinoma as given in the older literature, which includes anemia, cachexia, "ribbon-stools," and the symptom-complex characteristic of low intestinal obstruction, represents a terminal stage of the disease, which should never be allowed to develop in the presence of moderate methods of diagnosis and treatment.

#### DIAGNOSIS

It should be a cardinal principle in diagnosis to suspect the presence of a

rectal carcinoma in all patients past forty years of age in whom the regular routine of bowel action becomes upset. The presence of a malignant tumor of the lower bowel is also to be suspected in any adult in whom there is rectal bleeding which cannot be accounted for by parasites or bacteria.

Rectal carcinomata are usually correctly diagnosed if patients are intelligently and thoroughly examined. However, in many series of cases more than half of the rectal cancers are inoperable when first diagnosed, and the fact that 26 per cent of all cases diagnosed at the Mayo Clinic had previously been operated upon elsewhere for hemorrhoids without adequate preliminary rectal examination, demonstrates that most rectal examinations are woefully superficial.

Although not necessarily directly evidencing improper previous medical attention, it is nevertheless significant that the duration of symptoms at the time of diagnosis in most cases has been far too great. In a series of 41 cases reported by Turner the average duration of symptoms was nine months, and Rankin and Broders state that the duration of symptoms of patients seen at the Mayo Clinic averages more than twelve months.

Malignant growths are apt to be solid or hard; they tend to penetrate between the mucosa and the muscular coats of the bowel for some distance, and do not tend to project into its lumen, as previously stated; however, growths which do project into the lumen and which present a broad infiltrating base are to be considered malignant.

Two fairly characteristic types of rectal carcinoma may be described particularly:

- (1) A single elevated ulcer with necrotic crater and normal periphery, and
- (2) A firm granular bleeding mass growing somewhat into the lumen of the bowel and having an indurated base.

In addition to these two varieties representative of the medullary type of growth there is, of course, the scirrhus variety

which tends to produce an annular stricture.

In cases of doubt biopsy material may be taken deliberately and without hesitancy from projecting lesions, because they tend to be benign, but in the more suspicious cases and those in which the tumor mass is infiltrating in type, it is a safer procedure to be prepared to undertake operative treatment directly following the biopsy in case a "rush" frozen section indicates malignancy in the tissue removed.

#### MODES OF EXTENSION

Although fixation and marginal infiltration are characteristic of carcinomata of the rectum ordinarily, in its earliest clinical stages carcinoma of the rectum is confined to the rectal mucous membrane and the immediately adjacent submucous tissue. The growth is sessile and freely movable.

The extensions of the primary growth in accordance with which local fixation and distant metastasis occur have been described in classical form by Miles.<sup>12</sup>

Extension occurs by three different channels:

(1) By direct extension through continuity of tissue.

(2) Through the venous system.

(3) By way of the lymphatic system.

1. Primarily growth by direct extension occurs circumferentially in the mucous and submucous layers. The amount of circular infiltration, at least in cases involving the ampulla of the rectum, is roughly commensurate with the duration of the disease. Growths involving more than three-fourths of the entire circumference of the bowel have probably existed for more than one year.

Infiltration radially into the muscular tunics of the bowel wall occurs secondarily and fixation of the growth to the submucosa tends to begin at the oldest part of the neoplasm. Moderate fixation is characteristically established by the time one-half of the circumference of the rectum has become involved. In more advanced stages the neoplasm permeates structures

beyond the actual wall of the intestine, though permeation of extrarectal tissues is held in abeyance for a considerable period of time by a lymph sinus, which surrounds the rectum and separates it from the perirectal fat.

Penetration of the fascia propria occurs usually only after the growth has involved three-fourths or more of the circumference of the bowel which, as previously noted, indicates that the malignant process has been active for a year or more.

Fixation of the growth to the sacrum, prostate, bladder, uterus or vagina indicates extension of the neoplasm beyond the rectum except in certain cases in which the reaction is purely inflammatory and the fixation is due to excess fibrous connective tissue formation.

2. Venous extension constitutes a relatively rare mode of metastasis, but that it does occur is evidenced by the occasional accidental finding of carcinomatous nodules in the liver on opening an abdomen for carcinoma of the rectum obviously not very far advanced.

3. Lymphatic extension, by far the most important mode of metastasis, is by way of the lymph stream.

The lymphatics, draining the rectum, consist of an intramural group and extramural group.

The intramural group is a relatively unimportant one from the point of view of carcinomatous metastasis. There are in the rectum lymph vessels both in the submucous connective tissues and in the space between the circular and longitudinal muscle coats, both of which communicate by short radial vessels with one another and with the perirectal lymph sinus previously mentioned.

The extramural group is of far greater importance.

The extramural lymph-drainage system begins in a series of lymph glands which develop at different levels, along the rectum, which stud the surface of the rectum, and which are called anorectal glands. From these glands there are three

effluent lymph-routes: (1) the downward; (2) the lateral, and (3) the upward.

The downward route terminates in the internal iliac group of glands, having traversed the ischiorectal fossa and Alcock's canal; the tissues along this route include perianal skin, the ischiorectal fat, and the external sphincter muscle.

The lateral route terminates also in the internal iliac glands but traverses the area between the levator ani muscles and the rectovesical fascia, and includes in its course a gland near the obturator vessels; the tissues constituting the zone of lateral spread include especially (1) a group of lymph glands in the retrorectal space and (2) the levator ani muscles, but also the base of the bladder, the seminal vesicles in the male, and in the female the posterior wall of the vagina, the cervix uteri, and the base of the broad ligament, including Poirier's gland.

The upward route terminates mainly in a group of glands at the bifurcation of the left common iliac artery, having accompanied in its course the superior hemorrhoidal vessels behind the rectum, and also having traversed the retrorectal lymph glands and the subperitoneal area at the line of attachment of the pelvic mesocolon. From the uppermost anorectal glands lymph vessels also pass to the paracolic glands. The tissues included in this zone of spread are most important: the pelvic peritoneum, the entire pelvic mesocolon, and the paracolic lymph glands.

Although carcinoma of the lower part of the rectum tends to metastasize by the downward route, carcinoma of the upper part of the rectum to metastasize by the upper route, and intermediate carcinoma by the lateral route, all three routes intercommunicate, and carcinoma abides by no fixed rule in its metastasis.

#### TREATMENT

The treatment of cases of carcinoma is essentially surgical. The only known method of completely eradicating carcinomatous growths in the anus and rectum, as

elsewhere, is radical surgical extirpation, either with the knife, the actual cautery, or the high frequency current of electricity.

#### PALLIATIVE TREATMENT

As previously stated, due to the fact that the diagnosis of rectal diseases is backward, many cases of rectal malignancy are not diagnosed and referred to the surgeon at a sufficiently early time to permit satisfactory operative treatment; in such cases x-ray and radium therapy may be of considerable value in rendering the latter days of the patient comfortable; but with the exception of a few ultra-optimistic radiologists, the accepted opinion is that deep x-ray therapy and radium applications are valueless as curative agents. Lockhart-Mummery<sup>13</sup> says that x-ray and radium have probably never cured a case of carcinoma of the rectum.

The performance of colostomy is of the greatest value as a palliative measure in relieving obstruction, diverting the stream of irritating and traumatizing bowel contents from the region of the growth, and minimizing infection of ulcerated areas. Through the colostomy opening the lower bowel may be irrigated, and thus ulcerating areas may be actively cleansed of debris. Furthermore, the application of radium from above through the colostomy wound is made possible in certain cases.

The advocated methods for x-ray and radium therapy consist (1) in the insertion of heavily filtered gold seeds; (2) in irradiation by the element pack and (3) in the administration of high voltage roentgen rays. These methods should not, of course, be neglected postoperatively in cases of radical excision of growths in which their use is indicated, because of the suspected incompleteness of removal of neoplasms.

Lockhart-Mummery is virtually alone in recognizing the value of colloidal copper; he states that he knows of 2 cures in 200 cases treated by this agent. This author also thinks that colloidal lead holds some promise, but recognizes that it is a dangerous therapeutic agent.

#### OPERABILITY OF CASES OF CARCINOMATA OF RECTUM

The average duration of life in untreated cases with carcinoma of the rectum is twenty-one months. Lockhart-Mummery knows of one patient who lived seven years, but on the other hand, many patients die early. It is universally agreed that the most suitable cases for operation are those which present only a small local growth, and in which neither fixation of the rectum nor involvement of the regional lymph glands has occurred. In such cases Lockhart-Mummery reports 73.7 per cent of "five year cures."

However, it is not always easy to determine in any actual clinical case whether these conditions do or do not prevail until the abdomen has been opened, and in any event, in estimating the operability of a case the age of the patient cannot be overlooked, since in patients under thirty years of age the growth recurs promptly and with virulence in all cases. Lockhart-Mummery has never heard of a cure in rectal carcinoma in patients under thirty years of age. Tuttle states that no case of radical cure has ever been reported in patients under twenty-five years of age.

For obvious reasons metastases to distant parts, e.g. the peritoneum and the liver, contraindicate any but palliative operations.

Diffuse lymphatic involvement in the areas adjacent to the neoplasm does not necessarily indicate inoperability, since in many cases the glandular involvement is found not to be carcinomatous, but inflammatory at biopsy. Furthermore, satisfactory removal of the involved area is frequently possible.

Fixation of the growth may or may not indicate inoperability, depending upon the position, density and bulk of the limiting fibrous tissue. In certain cases it is possible to remove part of the prostate and the seminal vesicles in toto, and usually fixation to the hollow of the sacrum is not an insurmountable operative difficulty.

In deciding for or against operability

it is important to know that, except in young patients and in a few older patients who show early metastasis to the liver, metastases in rectal carcinomata occur unusually late in comparison with carcinomata elsewhere in the body. In contrast to gastric neoplasia, the size of rectal carcinomata bears no relation to the malignancy of the growth. Sixty-eight per cent of the cases in one series reported by Jones and McKittricks<sup>11</sup> showed no involvement of the perirectal tissues or lymph glands at autopsy. Miles finds metastases in his cases as follows:

- (1) To the inguinal glands, in 27 per cent of cases.
- (2) To the liver in 10 per cent of cases.
- (3) To the pelvic organs in 9 per cent of cases.
- (4) To the retroperitoneal glands in 6 per cent of cases.
- (5) To the lungs in 4 per cent of cases.
- (6) To the perineum in 3 per cent of cases.
- (7) To the femur in 2 per cent of cases.

Rankin and followers of the Mayo Clinic attach considerable importance to the determination of degree of malignancy according to the method of Broders. Rankin and Broders have found that their surgical results in grade 1 malignancies with metastases are almost as good as in grade 3 and 4 malignancies without metastases.

Rectal carcinomas showing marked tendency toward mucus production are relatively benign, and the greater the tendency toward mucus production, the more benign is the lesion. Ochsenhirt<sup>12</sup> graded 188 cases of carcinoma of the rectum for mucus content from 1 to 4, grade 1 representing a growth in which less than 25 per cent of all the cells were involved in mucus production, grade 2 in which more than 25 per cent and less than 50 per cent were so involved, grade 3 in which more than 50 per cent but less than 75 per cent, and grade 4 in which more than 75 per cent were mucus secreting cells. He then compared his grading for mucus production

with that of Broders for malignancy, and found an inverse ratio.

Summarizing the matter of operability, it may be said that some surgeons will choose to operate upon a larger number of cases than others, and the mortality rate and percentage of recurrences of such surgeons will tend to be high; others, more conservative, will refuse a larger number of operations with a corresponding decrease in mortality and morbidity.

In Rankin's series 51.7 per cent of cases were deemed suitable for either radical or palliative operative procedures, and this figure represents very well the situation with respect to the class of competent surgeons who are neither unduly radical nor unduly conservative.

Miles<sup>12</sup> in 1923 reported 489 cases of carcinoma of the rectum with a percentage operability of 29.3 per cent.

In Jones series, reported in 1928, the percentage operability was 65 per cent.

#### RADICAL TREATMENT

Because of the fact that carcinomas tend to invade the tissues of the host widely and because the limits of extension cannot be definitely outlined by any known means the mere local excision of malignant neoplasia anywhere in the body has rightly become an obsolete procedure except in a very few cases in which secondary infection or the mere size or position of a growth makes such a procedure desirable as a palliative procedure. Carcinoma of the rectum is no exception to the rule, and local excision of carcinomas of the rectum, except in a "very few exceptional cases, is no longer practised" (Lockhart-Mummery).<sup>16</sup>

Because of the position and physical relationships of rectal carcinomata the demonstrable limits of the growth are very difficult to determine. The rectum, lying as it does, in the depths of the bony pelvis is peculiarly inaccessible to ordinary non-surgical manipulative procedures, and a considerable part of the metastatic drainage area being deep in the abdomen,



evidences of metastasis to this area are also difficult to demonstrate or actually impossible of demonstration while the abdomen is closed. Since almost all of the advance in the surgical treatment of carcinoma has come about as the result of an understanding of the process of metastasis and the application of the principle of the wide excision of tissue for the purpose of removing all possible extensions of the malignant process, any operative attack which proceeds in the absence of a thorough examination for possible metastatic foci would seem to be irrational. For this reason the methods of operating upon carcinomata of the rectum which do not include a thorough exploration of the abdominal cavity and the concavity of the pelvis through an adequate abdominal incision are rapidly falling into disrepute.

If this operative principle is to be respected many of the older operations for carcinoma of the rectum must be considered obsolete. The most satisfactory of the operations of the type which proceeded in the absence of intra-abdominal and pelvic manipulations was the procedure most frequently known by the name of Kraske. Kraske did not introduce the method of perineal approach into surgery; the credit for this belongs to Lisfranc who practiced simple incision through the soft tissues of the perineum. The original operation was modified by Kocker in 1875 to include resection of the coccyx and by Kraske in 1885 to include resection of part of the sacrum for purposes of obtaining better exposure.

The classical Kraske operation as practiced for many years consisted in a preliminary colostomy, followed in a few days by removal of the coccyx together with the last segment or two of the sacrum and the radical removal of the growth through the portal thus formed. Many slight modifications enjoyed varying degrees of favor, specifically the modifications of Bardenheuer, Hochenegg, Rydygier, Rehn, Tuttle, and Murphy.

From the point of view of operative mortality the Kraske type of operation was not unsatisfactory. The mortality at the Mayo Clinic was about 25 per cent, and many surgeons, by subordinating the factor of completeness, were able to reduce the percentage of primary mortality to 15 or even 12, but the percentage of recurrences, regardless of the primary mortality, was invariably very high. As an example of the results obtained by excellent surgeons may be mentioned the statistics of Miles.

Between the years 1889 and 1906 Miles performed 55 operations for resection of the rectum by the perineal route, varying his technic slightly during this period of time. The operative mortality for every year but one was nil (1904-1905, 7.6 per cent) but the percentage of recurrences varied between 91.6 and 100 per cent.

In the early years of the present century, Miles was engaged in the development of a technic which would be capable of removing all of the tissues particularly susceptible to metastases.

According to Miles metastases may occur in the ischiorectal fat, the levator ani muscles, the retrorectal lymph glands and the pelvic mesocolon, and any operation for carcinoma of the rectum which does not remove these tissues, whether grossly invaded by carcinomatous nodules or not, is of relatively little value, since, at least theoretically, the removal of every microscopical evidence of the neoplasm must be accomplished in order to avoid recurrence.

This wide dissection is undertaken by Miles in one operation by a combined abdominoperineal approach.

Since 1906 Miles, (operation described originally in *Lancet* for Dec. 19, 1908 by Ernest Miles) has routinely performed the radical abdominoperineal operation, excising the pelvic colon entire (except the part utilized for forming a colostomy opening) the rectum entire, the pelvic mesocolon entire, the peritoneum lining the floor of the pelvis, together with a strip on either side of the parietal attachment of the pelvic mesocolon, the levator ani



muscles entire, the external sphincter muscle, as much as possible of the ischio-rectal fat, and a wide area of perianal skin.

From 1906 to 1920 he had performed 72 such operations with operative mortalities of 40, 26.3 and 18.1 per cent in three series consisting of 42, 19, and 11 cases, respectively, with a percentage of recurrence in the 55 cases which he was able to follow, of 28.5 per cent. Of the latter 55 cases the number of those known to have been alive and well in 1920 and the postoperative period covered were respectively as follows:

- 1—after eleven years
- 4—after nine years
- 3—after eight years
- 3—after seven years
- 4—after six years

Jones,<sup>17</sup> who is the most ardent advocate of the single stage resection of the rectum in this country, offers a technic which in outline is as follows:

#### PRELIMINARY PREPARATION

(1) The colon is cleansed by the administration of magnesium sulphate by mouth and the administration of enemas for several days.

(2) The blood-pressure is raised in cases in which an elevation is desired by the administration of ephedrine in doses of  $\frac{3}{4}$  grain T.I.D.

#### ABDOMINAL OPERATION

(3) Spinal anesthesia is induced, introducing the spinal needle between the first and second dorsal vertebrae.

(4) In the Trendelenburg position a long midline, or left rectus, incision is made.

(5) The liver is palpated for evidences of metastases and the pelvis is explored for enlarged glands.

(6) If the case is considered favorable for radical resection of the neoplasm, the intestines, except the sigmoid flexure of the colon, are packed off with gauze into the upper abdomen and the inferior mesenteric artery is ligated at a point about 1 in. below the bifurcation of the aorta, care being taken not to injure the left ureter.

(7) The peritoneum is incised on either side of the mesosigmoid down to the promontory of the sacrum.

(8) Using the finger, the pelvic meso-colon is separated by blunt dissection from the anterior surface of the sacrum as far down as the sacrococcygeal articulation.

(9) Traction is exerted on the bowel, and the peritoneum of the pelvic floor is incised forward to the base of the bladder in the male or the upper part of the vagina in the female.

(10) The anterior wall of the rectum is separated from the base of the bladder, in the male down to the upper border of the prostate (avoiding injury to the vas deferens and the seminal vesicles) and in the female from the posterior wall of the vagina.

(11) The lateral attachments of the rectum are divided down to the levator ani muscles.

(12) The rectum is divided with the cautery in a place favorable for colostomy, and the divided ends are invaginated by means of a purse-string suture.

(13) The distal end of the divided rectum is pushed down into the pelvis, and the pelvic peritoneal lining is restored, making peritoneal flaps from the base of the bladder in the male or broad ligament, in the female.

(14) Colostomy is performed, and closure of the abdomen is effected.

#### PERINEAL OPERATION

(15) The patient is turned on the abdomen and, with the hips elevated slightly, a purse-string suture is placed about the anus.

(16) An elliptical incision is carried through the skin from the sacrum to the perineum, skin flaps are dissected backward, and the coccyx is removed.

(17) The coccygeus muscle is divided, the distal end of the bowel is pulled down, and the levator ani muscles are divided at their point of origin from the lateral walls of the pelvis.

(18) The anal canal is dissected free

from the tissues anteriorly, care being taken not to damage the membranous portion of the urethra in the male.

(19) The large space latterly formed is left to fill by a process of granulation, rubber dam being placed in the bottom of the space and packing material being inserted to distend the space.

Jones reports Miles' complete statistics as follows:

In 116 cases the mortality rate was 25 per cent; the mortality prior to 1914, during the period in which generally anesthesia was used, was 36 per cent, but since 1914, using spinal anesthesia and nitrous oxide gas, it has been only 9.4 per cent.

Jones himself in January, 1928 had performed 15 radical one-stage operations for rectal carcinoma, with 1 death (mortality 7 per cent). The longest postoperative period of survival was two and one half years. Only 1 case showed recurrence.

Among American surgeons the one-stage radical operation for carcinoma of the rectum has not been very generally accepted. As early as 1914 Coffey had begun the elaboration of his classical "two-stage operation," and this operation has progressively increased in favor.

According to Coffey, few parts of the body are as favorably situated for the control of blood supply and removal of all necessary tissue as the rectum.

Most of the blood supply of the ampulla of the rectum and rectosigmoid as well as the other tissues in the hollow of the sacrum comes through the superior hemorrhoidal artery. The venous and lymphatic supply follows the artery.

The two-stage operation has the advantages that it does not place (1) the strain of repair of a widely traumatized area above the pelvic peritoneum, and (2) that of defense against infection from the region of the perineum upon the patient both at the same time.

A more radical procedure than his two-stage operation is irrational, according to Coffey, since the ideal to be striven for is

not the complete eradication of the malignancy at the expense of a high mortality, but rather the saving for patients as a whole of as many days of comfortable life as possible.

According to Coffey's development of operative technic, the essential part of the radical resection of the rectum was a laparotomy in which

(a) A permanent colostomy was made.

(b) Interruption of the blood supply and lymphatic drainage of the rectum at the promontory of the sacrum was performed by ligation of the superior hemorrhoidal vessels, and contiguous tissue, and the entire area thus devitalized was mobilized and pushed down within easy reach of a perineal incision.

(c) A so-called "quarantine pack" was placed over the devitalized area to prevent contamination of the clean area above by the devitalized area below and also to conduct away debris which would subsequently form.<sup>18</sup>

The next step in the evolution of the classical "Coffey operation" was the placing of a gauze wick drain in the hollow of the sacrum to protrude in the female through the posterior fornix of the vagina and in the male through an artificially fabricated tube of peritoneum to an opening in the skin of the anterior abdominal wall above the bladder and pubis.<sup>19</sup>

In order to adapt the general plan of the operation to carcinomata in the region of the rectosigmoid junction, in which class of cases inversion of the rectum was frequently impossible due to obstruction of the lumen of the gut, such inversion being an essential part of the technic previously developed, another modification was added. This consisted in complete mobilization (1) of the part of the rectum between the level of the promontory of the sacrum and the region below the growth, separating the rectum and perirectal tissues from the sacrum and coccyx behind and from the vagina in front, (2) doubly clamping the gut with long handled clamps and severing the intestine between the clamps, and (3)

removing the upper clamp together with the growth, and bringing the handles of the remaining clamp through the peritoneal encasement along with the quarantine pack.<sup>20</sup>

A similar procedure was adopted subsequently for growths low in the rectum which likewise did not permit the preliminary passage of a rectal tube for purposes of invagination. The growth, in this case was, of course, not removed until the secondary operation.

The second-stage operation follows the first after a period of time sufficient to ensure (1) firm union of the peritoneum above the quarantine pack, (2) complete healing of the abdominal wound and (3) satisfactory functioning of the artificial anus. At this time the patient's pulse and temperature should be virtually normal, and the function of the gastrointestinal tract above the artificial anus should be completely established.

The secondary operation removes the coccyx and lower piece of the sacrum and subsequently, by blunt dissection, the lower end of the rectum, quarantine pack, devitalized tissue and any pus which has accumulated. In the female the vaginal mucous membrane and perineum are split and the posterior wall of the vagina is either removed or left behind depending upon whether the growth impinges upon it or not.

Application of a large dose of radium is subsequently made in the cavity thus formed, either in conjunction with the primary operation or several days later

(usually four) in connection with the first or second postoperative dressing of the wound. Postoperative dressings are subsequently applied in such a manner as to enforce granulation from the bottom of the wound.

In 1924 Coffey<sup>20</sup> reported a series of 47 cases of patients operated upon by his method with only 2 deaths. He feels that the prognosis in cancer of the rectum when treated in this manner is better than that of carcinoma of either the stomach or uterus.

That not all authorities are agreed with regard to the opinions expressed by the most ardent advocates of the radical one and two-stage operations should be mentioned.

Rankin<sup>21</sup> reports 602 resections for true carcinoma of the rectum (omitting the rectosigmoid type) at the Mayo Clinic during the ten year period Jan. 1, 1916 to Jan., 1926 with a hospital mortality of 8.9 per cent.

The types of operation used during this period were,

- (1) Colostomy and posterior resection
- (2) "Jones" or "Miles" procedure
- (3) Coffey operation
- (4) Quenu-Tuttle or Harrison-Cripps type of perineal excision.

Jones believes the best operation for the average surgeon is colostomy and posterior resection of the rectum, but he thinks this is a compromise, the ideal operation being a one-stage abdominoperineal resection, and the next best operation being the abdominoperineal two-stage operation.

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# TECHNIC OF ROUTINE PRIMARY REPAIR OF LACERATED POST-PARTUM CERVICES IN PRIMIPARA

(A PRELIMINARY REPORT)

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LABOR has been described as physiological; recently more often as pathological. I wonder if it has not always been the same except that today we are better qualified to interpret correctly each influencing factor. Labor is and has always been destructive. Like a retreating army, it tears down the bridges behind it, entering an area of pathology. Many are the mothers who date their ill-health from a confinement.

Surgery in its early history was in the hands of itinerants; obstetrics was in the hands of midwives. Surgery has made greater strides because most surgery can be done at an appointed hour, when the operator is refreshed after a night's sleep and all essentials have been arranged.

Not so with obstetrical work. Most labors begin and terminate when the sun is beyond the horizon, during the hours intended by nature for rest and sleep. Those among us who have found it necessary to keep an operative engagement the morning after a sleepless night, know the effort required to be equal to the occasion.

A legend might very properly be written upon the revelations of the vaginal speculum. Cervices by the score, torn, lacerated, everted, excoriated; every stage of malignancy the finale of an early chapter. Volumes have been written upon "The Value of an Ideal." Inspiration born of desire leads us then to just one conclusion, namely, that each and every woman may enjoy the same health after her delivery as before her pregnancy.

"Inaction spells ruin." The medical world however is never inactive.

I am sold on the idea of routine primary repair of the post-partum cervix.

Visualize what confronts you at the

end of the second stage of labor; slight to moderate bleeding from a torn perineum, a torn cervix and partially separated placenta.

All vaginal tracts will have previously been swabbed or syringed with 4 per cent or stronger mercurochrome solution or other recognized antiseptic.

A yard roll is packed into the vaginal tract; all bleeding points in the torn perineum are tied; perineal sutures are placed but not tied. Yard roll is removed and placenta is delivered. Ergot or obstetric pituitrin or both are given hypodermatically.

Next to controlling the all-obscuring flow of blood, finding proper and practical bladder and perineal retractors proved to be no small task. These retractors, which are in use at the Chicago Lying-In Hospital, were finally found. However, the nurse holding the retractors and trying also to hold other instruments and sutures permitted the retractors to slide out of position. You can imagine the mess things were in during my early endeavors; blood flowing over everything, retractors slipping, while looking for the cervix I could not see.

Finally, I drew a diagram specifically stating the dimensions of all parts. This instrument which I submit for your inspection is the result. It is very practical (Fig. 1).

By use of this mechanical retractor in the post-partum vagina, the markedly edematous tissues and those parts that are thinned out and retracted can be more readily found. A headlight is the most satisfactory illumination.

To understand the points I wish to emphasize it is necessary to understand the mechanical features as I conceive them.

\* Submitted for publication May 19, 1930.

Note carefully the shape of the cervix at the end of pregnancy, as observed by Waldeyer, by Braune and Zweifel, and by

vaginal tract. Toward the end of the first stage of labor, you most often find a thickened resistant anterior lip grasping

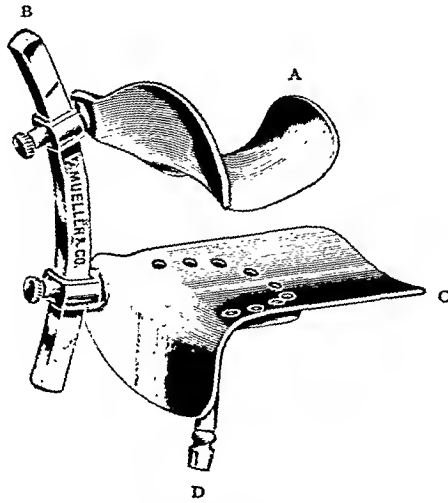


FIG. 1. Post-partum vaginal speculum. A. Vesicle blade hooks under os pubis holding firmly in place. B. Curve of bar spreads distal ends of blades. C. Perineal blade engages snugly in perineal pouch. D. Suction arrangement to keep field dry.

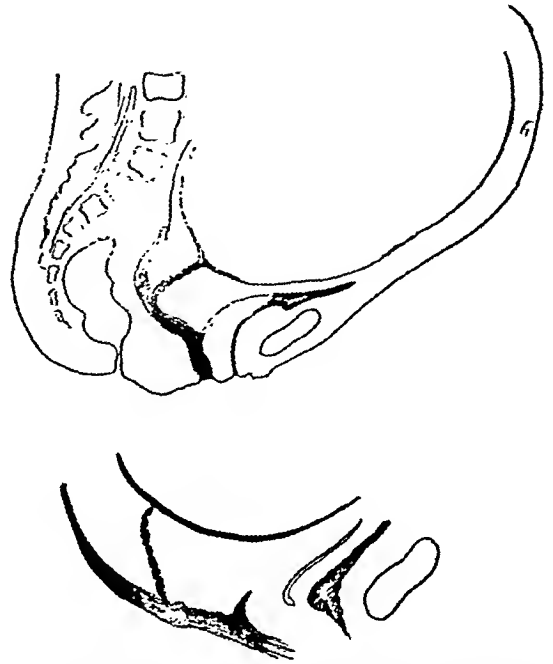


FIG. 3. Cervix at eight and one-half months, as observed by Waldeyer (Williams' "Obstetrics"), and as observed by Braune and Zweifel (Williams' "Obstetrics").

the author. The anterior lip is larger in every dimension, than is the posterior lip (See Figs. 2 and 3).

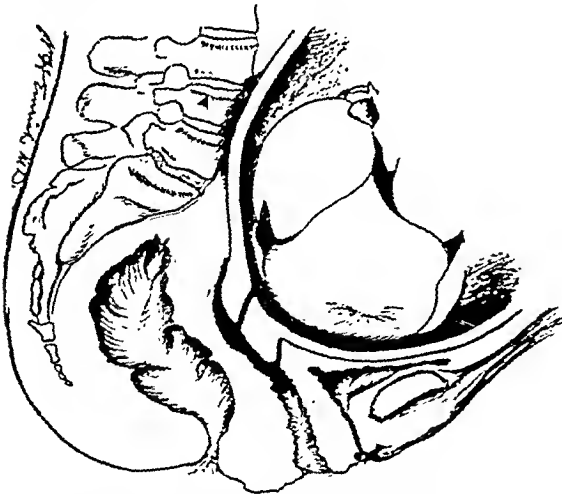


FIG. 2. Cervix primigravida at eight and one-half months. Note size and shape of anterior lip as compared with posterior lip. Pressure of gravid uterus on os pubis and anterior brim of pelvis increases from eight and one-half months until after delivery, causing edema of anterior lip.

the vertex, the posterior lip retracted high up and out of reach. And many is the time that we all make pressure upward on the anterior lip to expedite delivery.

The weight of the pregnant uterus rests heavily upon the anterior surface of the lower segment of the uterus, against the os pubis and the anterior brim of the pelvis (Fig. 2). This induces an edema of the anterior lip because there is no area in the anterior segment to take care of return circulation. During false and true pains this pressure with resulting edema is intensified.

The left occipito-anterior position is present in 70 per cent of vertex presentations. This is due to a full sigmoid pushing the pregnant uterus to the right. In labor this same empty sigmoid acts as a buffer, thereby permitting a return circulation from the posterior cervical segment and preventing edema in the posterior lip. The sacral promontory is the only point

When making a vaginal examination of a patient in labor, in the majority of instances you find the os far back in the

pressing hard against the uterus in back. Even the right iliac fossa in which the brow is engaged in a left occipito-anterior

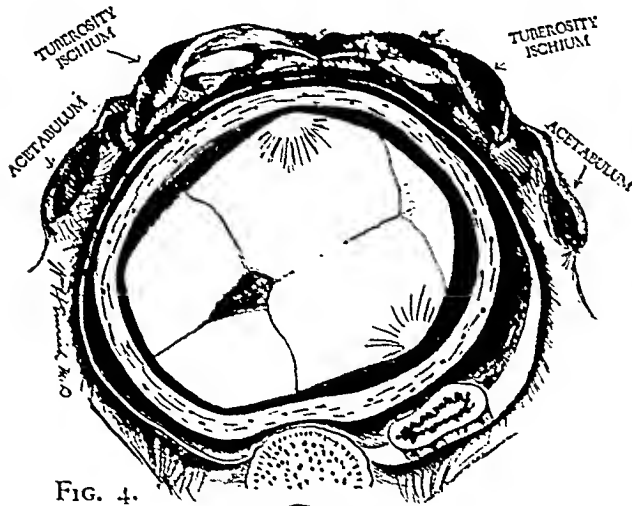


FIG. 4.

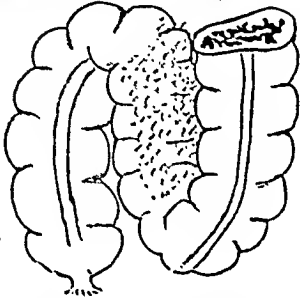


FIG. 5.

FIG. 4. Sigmoid as it crosses pelvic brim; acting as buffer between posterior surface of uterus and pelvic brim, permitting return circulation in and limiting edema in posterior lip of cervix.

FIG. 5. Continuation of sigmoid into true pelvis occupying left side of pelvic cavity, behind left broad ligament; distended it pushes pregnant uterus to right side of abdomen; distended slows up delivery; empty acts as buffer to posterior segment of uterus during labor.

position does not exert the same pressure as the os pubis and the anterior brim of the pelvis. Under these conditions the posterior half of the cervix does not become edematous and thickened, but is thinned out and retracts over the presenting part (Figs. 4 and 5).

In rachitic pelvis or any pelvis that does not conform to normal lines, there may be points of pressure posterior that might induce a thickened edematous posterior lip. Likewise I have observed in pelvis with a small circular rather than a normal sized oval inlet that the entire circumference of the dilating cervix is nearly the same in thickness.

#### TECHNIC OF THE ACTUAL REPAIR

Under thorough aseptic precautions, the vaginal tract having previously been

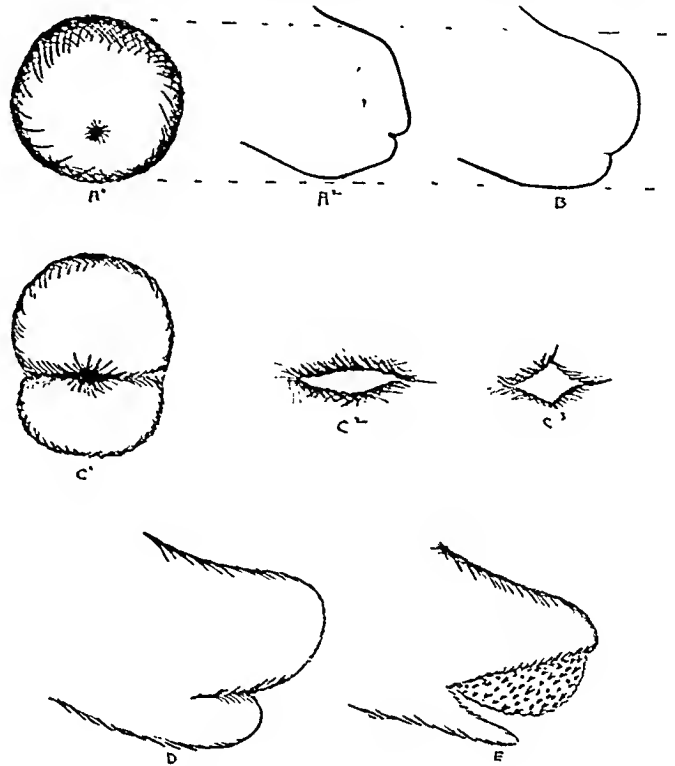


FIG. 6. A<sup>1</sup> and A<sup>2</sup>. Non-gravid, non-parous cervix, consistency of art gum. B. Gravid (early) non-parous cervix. Velvety to touch. C<sup>1</sup> Non-gravid multiparous cervix, old healed bilateral tear. C<sup>2</sup> and C<sup>3</sup>. Deep tears through internal os. D. Multiparous gravid cervix. Velvety to touch. E. Granuloma (chronic thick granulations) endometrium of bilaterally torn non-gravid parous cervix.

prepared according to indications, namely, if an active vaginitis and cervicitis are present, I advocate and use hychlorite douches one or more days ahead of delivery. As soon as the patient reaches the hospital she is given an enema, shaved, and if indicated a hychlorite douche. Pains are timed, vaginal examination is made, patient is moved to delivery room well in advance of delivery. I do not believe in waiting until the last minute for these reasons: you cannot have your patient under proper control; you do not have time to scrub properly. I want the nurse properly scrubbed up, the sterile goods and instruments properly spread. I do not like haste. Good team work makes obstetrical work just a little less trying.

The pubic region, thighs, buttocks and anal region are painted with mercurochrome solution. Mercurochrome is injected into vagina with bulb syringe or a swab is used.

Patient is delivered under an anesthetic.

If perineum is torn, which it most often is, bleeders are tied and sutures placed but not tied, just fastened with a hemostat. The placenta is delivered. Ergot alone, or combined with obstetrical pituitrin, is given hypodermatically. The anesthetist is asked to watch the fundus.

The post-partum mechanical retractor is placed. There are times when cervical tears bleed profusely. Then the suction pump is used until hemorrhage can be controlled by sutures.

The first tissue presenting is the vaginal surface of the anterior cervical lip, edematous, dark blue, the margins smooth. The gentlest handling serves best because the traumatized cervix is very friable. Using sponge forceps (which are unsatisfactory because sutures are occasionally passed through the fenestra, but because they do less damage than anything else that I have at this time), the cervix is picked up and the margins followed all around until the entire circumference is found.

The posterior lip is retracted, thinned out, irregular and beautifully macerated.

Cervical tears are in the shape of an "L," the end of the lower, the horizontal, bar right at the margin of the os proper. This is true on both sides except that the "L" on the patient's left side is a reversed "L." Interrupted through and through sutures of No. 4 forty day chromic catgut are placed from bottom of tears right up to the os proper. The anterior and posterior lips are carefully approximated. No sutures are drawn tight. I have failed at times to place sutures close enough to the small os. The result in those cases has been very disappointing.

Iodoform gauze strip is placed against cervix and out of vaginal orifice for twenty-four hours.

The judicious administration of flex. ergot is absolutely necessary, drams  $\frac{1}{2}$ , every two hours, to prevent clot formation,

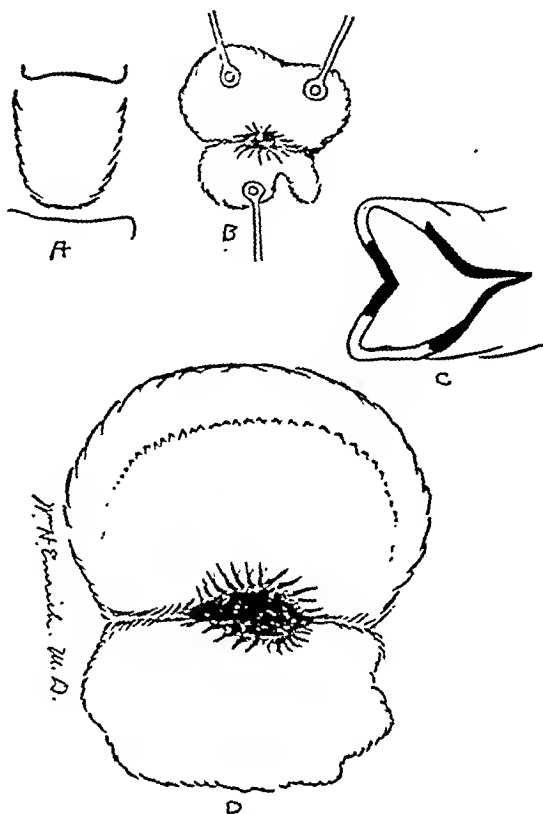


FIG. 7. Primiparous post-partum cervix. A. Vaginal surface of anterior lip, as seen through speculum. B. Method of grasping with sponge forceps. C. Textbook illustration, incorrect. D. Accurate drawing of primarily torn post-partum cervix.

the passage of which would tear out practically all sutures, thereby undoing all our work and efforts.

Occasionally I replace the iodoform gauze if conditions indicate. This can be readily done by drawing patient to edge of bed, placing one foot on bedside table, carefully using bivalve speculum and headlight.

The clinical incubation period for vaginal bacteria is five days. At this time the lochia become offensive. This is the time when lymphatic absorption would be disastrous, repair or no repair. For years I have had post-partum cases douched with hychlorite solution from the fifth day on.



Examine your patient two months later and decide for yourself.

#### THE IMMEDIATE BENEFITS

There is less post-partum flow; especially is it noticeable that the first twenty-four hour lochia is reduced. In none of our primarily repaired post-partum cases have large vaginal clots been evident.

The lying-in period seems productive of quicker convalescence. There seems to be the same comparative difference between a primarily repaired post-partum case and one not repaired as there is between a thin wiry postoperative patient who is ready to leave the hospital in ten days as compared to the adipose asthenic type hospitalized for twenty-one days.

In other words the morbidity is very definitely reduced.

#### THE ULTIMATE BENEFITS

Leucorrhœal conditions are less likely to

result, less troublesome if present and respond more promptly to treatment.

Erosions and excoriations not previously present are less likely to result and if present heal more promptly.

Since 90 per cent of cervical cancers are implanted on lacerated cervixes, the primary repair of post-partum cervixes is an invaluable prophylactic measure against future malignancy.

#### SPECIAL OBSERVATION

For several years I have chemically tested the reaction of the cervical mucosa of gynecological patients and find it consistently alkaline. I have likewise at the same time examined the vaginal mucosa and invariably find it acid and sometimes highly acid. An everted alkaline cervical mucosa lying in a pool of acid mucus day in and day out is ultimately destined to undergo inflammatory reaction and organic change, the final results one can readily visualize.



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\*Continued from p. 556.



# NEW INSTRUMENTS

## AN IMPROVED FOOT SUPPORT ATTACHMENT

FOR THOMAS SPLINTS\*

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ONE of the most annoying difficulties connected with the care of a fracture treated in a Thomas splint is that of

The contours are such that the foot piece may be used on either foot. In a later model the foot piece has been made of  $\frac{1}{8}$  in.

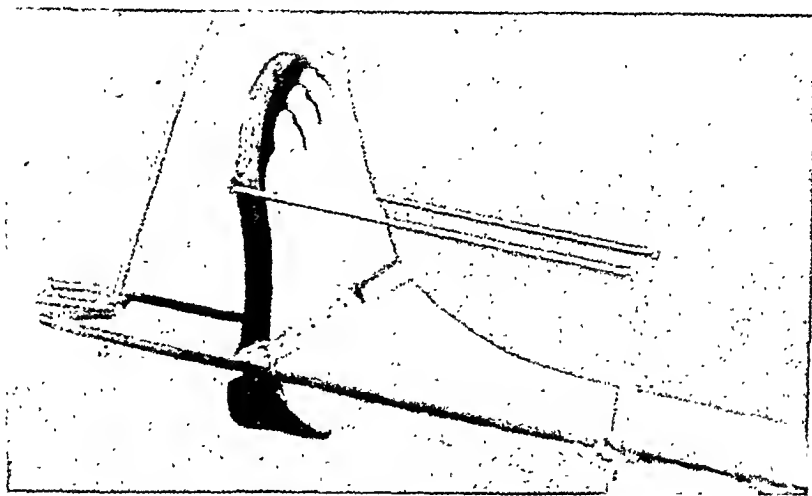


FIG. 1. Improved foot support attachment for Thomas splints.

maintaining the foot in dorsal flexion. The appliances in general use tend to get out of adjustment frequently or are uncomfortable.

The apparatus illustrated herewith was designed by the writer and has been used on a number of patients for more than a year. It has the proved virtues of simplicity, easy adjustment, stability, comfort, cleanliness and durability and is inexpensive to make.

The apparatus consists of a wooden or celluloid foot piece with a leather strap, two coiled steel wire springs, and two detachable lugs with steel uprights. The foot piece is roughly shaped to the contour of a foot, has a hard leather spur piece behind the heel and a strap attached which passes across the front of the ankle.

sheet celluloid, cut to a pattern in one piece, heated and molded on a wooden model. The spring is 9 in. long, of  $\frac{1}{4}$ -in. 14-gauge steel wire, nickel plated. The detachable uprights are made in two parts, the lower consisting of the slotted lug with a wing set screw, and the upper consisting of a thin blade of 16-gauge Sheffield steel, 5 in. long by  $\frac{5}{8}$  in. wide, the base of which is welded into a shallow slot in the upper face of the lug. The lug is made from cold rolled steel  $\frac{5}{8}$  in. in diameter by  $\frac{7}{8}$  in. long, and a slot  $\frac{5}{16}$  in. wide by  $\frac{9}{16}$  in. deep is milled in the lug at an angle of  $45^\circ$  with the side. The lower end of the lug is drilled and threaded at the center to receive the wing screw, size 8, 32 threads to the inch. The upright is nickel

\* Submitted for publication June 23, 1930.

plated and polished. The cost of materials and labor has been approximately \$2.50 for each completed foot support.

point to give the foot support with comfort. The moderate elastic tension against the sole of the forefoot is comfortable and

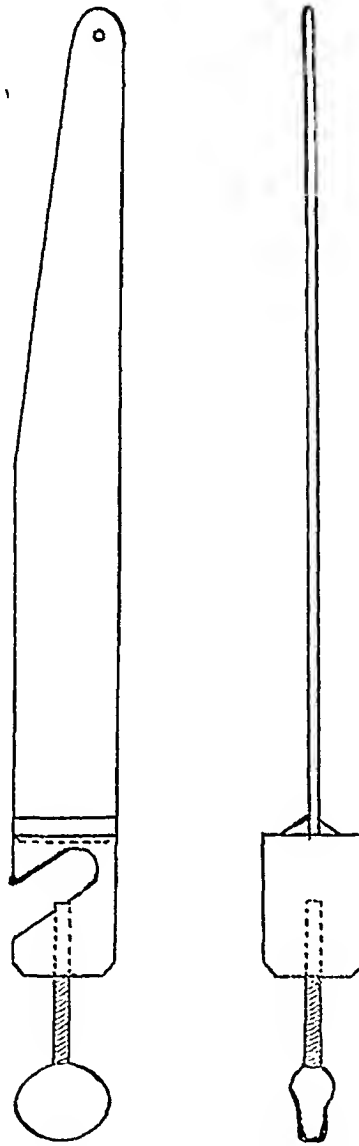


FIG. 2. Construction of uprights (actual size).

When the patient's leg has been suspended in the Thomas splint or Pierson knee flexion attachment, the slings, traction bands and the spreader and weights are adjusted, the foot piece can then be buckled to the foot and the uprights attached to the splint bars at the proper

encourages active exercise but the foot piece stays in place regardless of the direction or amount of ankle motion.

If the apparatus is properly constructed and applied, it does not impinge upon or interfere with any other parts of the apparatus for traction and suspension.

# CASE REPORTS

## DIVERTICULA OF THE APPENDIX\*

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THE first definite description of a dilatation of the appendix with a retained mucous or mucoid fluid was by Rokitansky in 1842. Gähtgens spoke of an autopsy finding in 1853, and Virchow in 1863. Rokitansky expressed the opinion, in 1867, that this condition was a colloid carcinoma. Steiner reported, in 1882, that in 2280 autopsies he found 3 cases of hydrops of the appendix. After 1890, when abdominal operations became more frequent, the condition was not so rarely observed; yet Stengel, in 1906, reported having observed but 1 case in 2000 autopsies. Von Bruns, in 1905, was one of the first to describe the pathogenesis of diverticula of the appendix.

The condition, while rare, is common enough to excite interest.

McGrath and MacCarty found 17 diverticula in 5000 appendices (.34 per cent).

Konjetzny found 2 diverticula in 1000 appendices (.2 per cent).

Moschowitz found 4 diverticula in 1500 appendices (.26 per cent).

Mertens found 3 diverticula in 106 appendices (2.8 per cent.)

Stout (Presbyterian Hospital) found in 264 cases operated upon for appendicitis from July 1, 1921 to June 30, 1922, a percentage of 1.89.

At the Lenox Hill Hospital among 5283 appendices examined in the pathological laboratory there were found 9 cases (.17 per cent).

True congenital diverticula are extremely rare, only 1 case being found in the literature, that described by Edel.<sup>1</sup>

<sup>1</sup> Virchows Arch. f. path. Anat., 138: 1894.

\*From the Surgical Service of Lenox Hill Hospital; Dr. Hermann Fischer. Read before the Surgical Section of the New York Academy of Medicine, April 4, 1930.

In this type the walls of the diverticulum retain all the coats intact. There is, in contradistinction to the acquired type, no absence of the muscularis or submucosa at any part of the circumference of the sac. Several cases of congenital diverticula are reported, and if one were to read titles only, one might be misled as to the rarity. However, a perusal of the microscopic examinations by the pathologists soon dispels the illusion.

The acquired types are inflammatory and non-inflammatory in character, of which the former are the more common. The formation of the non-inflammatory type is probably analogous to the formation of diverticula of the colon. That is, they are supposed to be formed by a pouching of the mucous membrane and serosa alongside the artery which passes through the outer coats to the mucous membrane practically at a right angle. This is supported by the fact that the usual location of diverticula is between the leaves of the mesentery. In order for this pouching to occur there must be some pressure exerted in the lumen which forces the mucous membrane through the weakest point. This pressure need not necessarily be of great force, yet it must be constant or frequently repeated, and become increasingly greater as time goes on. One might even venture the opinion that all acquired diverticula are of inflammatory origin, at least indirectly if not directly. I say this, because in order to have this pressure gradually (in all likelihood very gradually: else there would be too much pain) increasing, there must be some blockage to the normal physiological drain-

age of the appendicular lumen. The most common form would be a cicatrix near the base due to some previous inflammatory process. If the pressure is sufficiently great and forces a small pouch out alongside the artery somewhere distal to the cicatrix, we have a diverticulum which is acquired and non-inflammatory, but indirectly due to a previous inflammatory process proximal to the site of the diverticulum.

Stout endeavored to reproduce this condition experimentally by taking fresh appendices, closing off the lumen at the base around a small tube, and forcing fluids into the lumen under considerable pressure. However, diverticula did not develop. It seems to the writer that conditions as they exist in vivo cannot, in this instance, be reproduced *ex corpore*. When the appendix is still part of one, there is probably never so great a pressure in the lumen, and, experimentally, this pressure can be maintained for only a comparatively short time. It is easy to conceive that slight pressure, exerted constantly, or frequently repeated, over a considerable period of time, and gradually increasing in intensity, will weaken the muscular coat at the point of perforation of the artery to such an extent that a pouch of mucous membrane would protrude.

The inflammatory type always follows some previous inflammation of the appendix. At one of the sites of a local inflammation in the lumen of the appendix the muscularis is weakened or destroyed. The mucosa heals from the edge toward the center and prevents the reunion of the muscle coat. A probable reason why this condition does not occur more often is the variation in the ratio between the amount and rapidity of necrosis and repair. At the same time, or at a later attack, somewhere proximal to this point, there is considerable destruction with the subsequent formation of an annular cicatricial constriction, causing either a partial or complete occlusion of the lumen. We then have a blind sac formed by the distal

portion of the appendix, the intra-appendicular mucocele. The mucous membrane in this portion still secretes, the pressure becomes increasingly greater, the weakest point is at the site of the previous inflammation, the mucosa is pushed out, and we have a pouch composed of mucosa, serosa, submucosa, and in only a part of the wall is there any muscularis; in other words, a pseudodiverticulum. The contained fluid may burrow between the coats of the appendix, and if a cross section of this appendix be made we get a picture of a double lumen, only one of which will have a muscular coat for part of its circumference.

If the cicatrix at the proximal portion of the appendix causes a complete blocking of the appendicular lumen so that absolutely no fluid can escape into the cecum, and neither can any colon contents flow the other way, the fluid contained in the distal portion soon becomes sterile and gelatinous. The diverticulum may leak, and some of this fluid run between the leaves of the mesentery. If the patient be operated upon at this stage a condition will be found which has been described as extra-appendicular mucocele. Going only a step further we can visualize this fluid getting into the peritoneal cavity. As this fluid is not irritating, and some secretion still persists from small portions of mucosa, a large amount may collect before the patient's symptoms become severe enough to require operative interference. The condition now is what is usually termed a pseudomyxoma peritonei.

In looking through the literature we found many terms used to describe various conditions: such as, hydrops of the appendix, mucocele of the appendix, together with the different terms mentioned before. It is the opinion of the writer that the mechanism for the formation of all these conditions is the same as that for the formation of diverticula, and that these terms are merely names for slightly different phases of the same pathological condition.

Clinically these cases are practically never diagnosed before operation. The patients are usually operated upon for acute or chronic appendicitis. There is, however, one significant point in the history that might lead one to suspect the possibility of a diverticulum being the underlying factor in the ailment. This is a slow onset. In some cases the patient will complain of a slight feeling of discomfort in the right lower quadrant, or even slight recurrent attacks of pain over a period of weeks or months, and yet not severe enough to cause cessation of work. Gradually these pains become more severe, so that at last a picture of acute appendicitis is presented. This type of history will be more often elicited in private cases than in the usual ward case.

#### REPORT OF CASES

CASE 1. T. B. (18578) Male, forty-five years of age. Patient admitted to Lenox Hill Hospital on March 15, 1928 complaining of abdominal pain and vomiting for three days prior to admission. The pains were at first vague and not localized to any portion of the abdomen. On the second day they were localized to the right lower quadrant and did not radiate. Vomiting set in. His past history is negative except for typhoid in 1907. The physical examination was unimportant except for the rigidity over McBurney's point, and rebound tenderness. Temperature on admission 100.2°F., pulse 98, respirations 24. The urine showed 2+ albumin, and hyaline and granular casts. Blood count was not done.

*Operation:* Kammerer incision. The appendix lay in the inferior ileocecal fossa, much thickened and infiltrated, and covered with fibrin. The tip was ruptured and there was free pus. Typical appendicectomy with two cigarette drains, one to the stump and the other into the pelvis.

*Pathological Report by Dr. Bullock* (Laboratory No. 23658): The specimen consists of an appendix 5.5 cm. by diameter proximal 0.6 cm. by distal 1.2 cm. The surface is covered with thick fibrinous exudate, disclosing after removal a blackish-blue serosa. The distal 1 cm. is thickened and bent, and shows several elevations on its surface. The lumen in the proximal

end is obliterated, but in the remaining four-fifths of the organ it is dilated and filled with gray black material. The walls are thickened. There are four diverticula leading into the thick inflamed mesoappendix. *Microscopic:* Sections of the appendix show extensive necrosis, associated with a generalized purulent infiltration. In areas the necrosis involves all the layers of the wall. Sections through the mesoappendix at right angles to the diverticula show the latter to be lined with mucous membrane outside of which is a large amount of muscle which in places show distinct longitudinal and circular coats. The mucous membrane of the diverticulum shows varying degrees of necrosis and the surrounding tissue is infiltrated with many cells.

Patient made uneventful recovery, and was discharged on April 6, 1928.

CASE 11. E. O'F. (18476) Female, aged twenty, telephone operator. The patient does not complain of any subjective symptoms, nor can any objective ones be elicited. She has had two attacks of appendicitis, one in 1923 and one in 1927. At the last attack there was generalized abdominal pain, which became cramp-like, and localized in the right lower quadrant. Two months ago she was advised to submit to operative interference. The physical examination was absolutely negative. The urine was normal. Temperature 99°F., pulse 82, respirations 20. The diagnosis of chronic appendicitis was made from the history.

*Operation,* March 8, 1928: Kammerer incision. Numerous adhesions were found in the cecal region. The appendix was retrocecal and adherent. There was a large movable stone in the proximal half. After the appendix was delivered, it was found to be in two segments, the distal portion having been spontaneously amputated. The ends of the lumen were closed and the segments adherent to each other by a small band of fibrous tissue. Appendicectomy *ad secundam artem*.

*Pathological Report by Dr. Bullock* (Laboratory No. 23607): Specimen is an appendix 3.2 cm. by 1 cm. The serosa is roughened, dark brown, and dull. The lumen is very large and contains a hard brown fecalith. The walls are very thin and fibrous in texture. There is an almost entire disappearance of mucosa. There is in the mesoappendix a small oval mass 1 cm. long which seems to be partially calcified

with a central greenish area, and a tough fibrous peripheral section.

*Microscopic:* Section of the appendix shows

vealed nothing except tenderness over the entire lower abdomen, most marked over McBurney's point. There was distinct rebound



FIG. 1. Four diverticula in one appendix.



FIG. 2. Portion of appendix shown in Figure 1, showing double lumen.

dilatation of the lumen and atrophy of the wall involving chiefly the mucosa and the lymphoid tissue. The former appears to be everywhere intact though extremely thinned out in places. There is a localized fibrous thickening of the serous coat, associated with extensive hemorrhage. Section of the nodule from the mesentery shows circumscribed appendicular tissue including all the coats. In one place there appear to be two distinct lumina, each bordered by intact mucous membrane and apparently possessing separate and distinct submucous and muscular coats. Several isolated gland tubules are noted in the submucosa. The lumen contains amorphous material showing deposits of lime salts. The wall is sclerotic, and the surface is thickened by fibrosis and shows hemorrhagic fibrous adhesions. The sequestration of this mass of appendix in the mesentery is probably explained by spontaneous amputation of a diverticulum.

The patient was discharged after an uneventful recovery on the tenth day.

**CASE III.** A. C. (18807) Female, aged twenty-nine, nurse-girl. On admission, April 7, 1928, the patient complained of pain in the right lower quadrant of one day's duration. The pain began the night before admission, and was accompanied by constant nausea, but no vomiting. She had had one similar attack six months previously, at which time she had vomited several times. Other history was negative. The physical examination re-

tenderness, but no masses palpable. Vaginal examination was negative except for tenderness in the right fornix. Blood count showed 14,200 white cells with 72 per cent polymorphonuclears. The urine was negative. Temperature on admission 100.8°F., pulse 88, respirations 20.

*Operation* on April 9, 1928: Kammerer incision. The appendix lay retrocecal, embedded in thick adhesions. The base was free. Appendectomy *lege artis*. A small drain was inserted.

*Pathological Report by Dr. Bullock* (Laboratory No. 23804): Specimen consists of an ovoid mass 7 cm. by 4 cm. The external surface is brown and granular. The cut surface shows a lumen surrounded by a gelatinous, yellowish-white tissue, with an area of liquefaction adjacent to the lumen previously described.

*Microscopic:* Sections of the appendix show marked thickening of the wall, due partly to fibrosis and inflammatory exudate, and partly to hyperplasia of the muscular coat. One section presents a lumen which is bordered by an intact mucous membrane, the glands of which are large and rich in goblet cells. This is bordered on one side by the submucosa, muscularis and serosa. The muscularis is very irregular, and in one place encloses a mass of fibrous tissue, which may possibly represent

an obliterated lumen. At a point where there is a break in the muscularis, there is a second lumen, one side of which is bordered by mucous



FIG. 3. Three illustrations of diverticula from different appendices.

membrane showing large areas of necrosis and suppuration. The other side of the lumen is bordered by a thick mass of fibrous tissue containing strands of smooth muscle. The greater part of the tissue is transformed into myxomatous tissue which shows areas of necrosis and suppuration. Near one surface of the appendix there is a sacculated gland tubule lined with cylindrical cells and embedded in fibrous tissue. The fibrous tissue is almost completely surrounded by smooth muscle showing a suggestion of a circular coat. The outer surface of the appendix shows areas of necrosis, suppuration, and fibrinous exudate.

The patient was discharged, cured, on the fourteenth day.

**CASE IV.** H. A. (21178) female, aged forty-two, housewife. The patient was admitted to the hospital on December 3, 1928 complaining of vomiting and abdominal pain for the past forty-eight hours. She had had no previous similar attacks. During the first twenty-four hours she vomited four times, and had had rather loose bowels. No vomiting occurred during the second twenty-four hours, but she felt severe drawing pains in the umbilical region. Her previous history was irrelevant. Menses had always been regular and painless. Physical examination revealed a rather fat

distended abdomen. There was marked redness over the lower abdomen due to a hot water bottle. In this portion there was definite



FIG. 4. Sections of appendix at two different levels, with diverticulum shown at left.

tenderness, most marked over McBurney's point. Rigidity was lacking. Vaginal examination was negative except for tenderness in the right fornix. No other pathological findings were elicited. Admission temperature, 101.2°F., pulse 114, respirations 24. The urine was normal. Wassermann reaction, negative. The patient came to operation for acute appendicitis. An appendicectomy was done in the usual manner except that the stump was not buried. At operation the appendix was found to lie in the retrocecal position, curled up, and held by firm adhesions.

*Pathological Report by Dr. Bullock* (Laboratory No. 24998): Specimen consists of an appendix measuring 8 cm. in length and 0.8 cm. in diameter, somewhat dilated at the tip. The surface is rough, deeply injected, and covered with a grayish exudate and adhesions. At the tip it is covered by dark hemorrhagic areas and is edematous. The lumen is patent throughout and is filled with fecal matter. The mucosa in the proximal portion is thickened, while in the distal extremity it is thinned, hemorrhagic and necrotic. *Microscopic Examination:* Section of the distal part of the appendix shows extreme necrosis which is confined to the inner layers of the wall. The necrosis is associated with purulent infiltration and extensive hemorrhages. The lumen is extremely dilated and in one area shows a false diverticulum. Section through the proximal part shows fibrosis of the wall and necrotic patches in the inner layer.

**CASE V.** J. G. (P2808) male, aged thirty-two, contractor, was admitted to the hospital on November 28, 1928 complaining of pain in the right lower quadrant of sufficient intensity to cause his ceasing work, but not severe enough to keep him from walking around.

For the last two years he had noticed similar pains at more or less irregular intervals. One year ago, during one of these attacks, a physician had made the diagnosis of appendicitis. Ice bags applied to the abdomen relieved him for the time being. From that time he had had occasional days when he felt sick, but, as he says, "nothing serious." Physical examination revealed a man 5 ft. 7 in. tall, weighing about 195 lb., and too fat. He was sick enough to be petulant, but not, apparently, acutely ill. Heart and lungs were negative, the abdomen protuberant. Between the umbilicus and the anterior superior spine a definite mass, the size of an orange, could be palpated with ease. There was marked rigidity on the right side. Rectal examination was negative. The urine showed 3+ albumin, and hyaline and granular casts. Blood count was not done. Admission temperature 103.2°F., pulse 128, and the respirations were 28. Immediate operation for acute appendicitis with localized peritonitis and abscess formation.

*Operation:* Kammerer incision. On opening the peritoneum a mass of highly inflamed omentum was found surrounding the caput coli. On freeing this omentum, about 10 c.c. of pus escaped into the wound. Below the omentum was found a highly inflamed, infiltrated hard mass with many adhesions, which gave one the impression that it might be tuberculous, carcinomatous, or actinomyotic. With considerable difficulty the tumor was freed, and finally an appendix was shelled out of the mass. The base of the appendix was an inch in diameter, and the form much distorted. The lumen was very small, but the walls were at least half an inch thick. Appendix removed, drainage tubes inserted, and the abdomen closed in layers to the drains. On the ninth day a secondary abscess had formed which was evacuated by inserting the finger through the drainage canal and in between the retaining loops of intestine. A fecal fistula developed, but otherwise there were no complications in the convalescence.

*Pathological Report by Dr. Bullock* (Laboratory No. 24967): Gross appearance: The specimen, received in formalin, consists of an appendix and a mass of inflammatory tissue. It measures 6 × 5 × 3 cm. *Microscopic:* Section through the mass reveals an appendix containing two rather large and apparently separate lumina bordered by mucous membrane. The entire wall is greatly thickened by

fibrosis and the products of an acute and chronic exudative inflammation. In one area there is a large and ill-defined abscess. Elsewhere the wall is richly infiltrated with small round cells. Throughout the wall are numerous small hemorrhages. Attached to the appendix is a mass of inflammatory fat tissue.

*CASE VI.* W. F. M. (P1973) male, aged forty-two. The patient was admitted to the hospital on April 14, 1928 complaining of pain in the right lower abdomen. Two days previous to his admission he was seized with generalized abdominal pains, not radiating, but later localizing in the right lower quadrant. No vomiting or other symptoms. His bowels have been moved with laxatives. No urinary symptoms. The pain has been getting progressively worse, and today he had pain when walking and difficulty in standing up. His previous history is negative except for typhoid fever many years ago. He has never had a similar attack. The physical examination revealed nothing outside the abdomen. The abdomen was not distended, and there was no generalized tenderness or rigidity. At McBurney's point there is some rigidity, and in this area a hard tender mass is palpable. Rectal examination is negative. Urine normal.

*Operation:* Kammerer incision. There was no free fluid on opening the peritoneum. A tumor, almost grizzly hard, was found in the region just below the cecum, and forming part of the cecal wall. The surrounding tissue, especially the mesentery of the lower ileum, was thickened and hard. With difficulty this mass was entered and about 2 oz. of thick yellow pus was evacuated. It was difficult to make out the appendix because of the matting together of the tissues. The appendix was removed but the stump could not be inverted on account of the infiltration. Two drains were inserted. Closure in layers to the drains.

*Pathological Report by Dr. Bullock* (Laboratory No. 23850): The specimen, received in formalin, is an appendix 5 cm. in length by 0.8 cm. in diameter. The whole appendix is covered with organized exudate and fat to such a degree that the original organ can only be seen on section. The lumen appears to be obliterated. The walls are thick and tough. *Microscopic:* Sections of the appendix show a generalized overgrowth of fibrous tissue and two large areas of fatty infiltration. All epithelial structures are missing, and the



lumen is obliterated by granulation tissue. The lymphoid tissue shows localized hyperplasia. The wall is irregularly infiltrated with inflammatory cells. Outside of the muscular coat there is a large abscess bordered by granulation tissue, to one side of which is a well-defined, though irregular, second muscular coat.

The patient was discharged, cured, on May 24, 1928.

CASE VII. M. J. (20447) female, aged thirty-eight, housewife. The history is irrelevant so far as the appendix is concerned. She was operated upon for bilateral salpingo-oophoritis, and the appendix was removed incidentally. Equally unimportant, from our standpoint, is the physical examination.

*Pathological Report by Dr. Bullock* (Laboratory No. 26835): The specimen, received in formalin, consists of an appendix, measuring 6 cm. in length by 1.3 cm. in diameter. The peritoneal surface is covered by torn fibrous adhesions and hemorrhages. On section the lumen is patent throughout, and empty. The mucosa is thickened, but shows no gross lesion. The wall is thickened by an increase in fibrous tissue, and contains small hemorrhages. *Microscopic:* Sections of the appendix show the wall to be thickened by a more or less generalized overgrowth of fibrous tissue and hypertrophy of the muscle coat, and is infiltrated with inflammatory cells. These cells are rather few in number, except in the thickened outer coat where they are abundant and consist largely of small round cells. Attached to the outer surface are inflammatory fibrous adhesions. The lumen is, for the most part, of small caliber, and in one place the epithelium bordering it is eroded away. The mucous membrane in this area is atrophic and shows

an increase in fibrous tissue. The lymph follicles are moderately hyperplastic. In one part of the organ there is a small round canal which is directed perpendicular to and communicates with the lumen. This canal passes through all the coats and forms a nodule on the outer surface where it is slightly dilated and covered with thickened serosa. It is surrounded by mucosa and submucosa, though in one area the mucous membrane is eroded away. There is no marked inflammatory reaction about this false diverticulum.

CASE VIII. C. B. (19157) female, aged forty-three, housewife. The history, so far as the subject in hand is concerned, is irrelevant. She was operated upon, primarily, for a fibroid of the uterus. The appendix was removed at the same time. The physical examination revealed nothing abnormal about the appendix.

*Pathological Examination by Dr. Bullock* (Laboratory No. 23964): The appendix is 5.5 cm. in length by 1 cm. in diameter. Its outer surface is slightly congested. On incision its walls seem thicker than normal, though they do not appear inflamed. The mucosa is glistening throughout, but it is somewhat corrugated and also seems thicker than normal. The lumen is patent throughout.

*Microscopical:* Sections of the appendix show a narrow lumen bordered by an intact mucous membrane. The lumen is eccentrically placed, and one of the sections shows a second lumen incompletely lined with mucous membrane. The remainder of the wall shows fibrosis, fatty infiltration of the submucosa, and hypertrophy of the muscularis. The lymphoid tissue is very scant and there is but little cellular exudate.



# COMPLETE ACCIDENTAL CUTTING OF URETER DURING LAPAROTOMY

WITH NON-SURGICAL ANASTOMOSIS;  
REPORT OF CASE\*

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**R**EALIZING the frequency with which ureters are accidentally tied and cut during laparotomy, my only excuse for reporting this case is its unusualness.

## CASE REPORT

Patient M. D. Female aged thirty-two. Negress, admitted to the Gynecological service November 21, 1929, with provisional diagnosis of salpingitis and oophoritis. After several days she showed signs of ruptured ectopic pregnancy. Her blood picture on December 2 was as follows: erythrocytes, 1,356,250; leucocytes, 26,400; hemoglobin, 32 per cent, blood Wassermann reaction 4+. Repeated urinalyses showed 2-4+ albumin, also many hyaline and granular casts and many clumped pus cells. She was transfused and on December 3, under general anesthesia a celiotomy with removal of products of pregnancy was done as follows:

"Midline incision. Before opening peritoneum, dark blood could be seen through it. Peritoneal cavity was filled with large blood clots. The right tube was enlarged and ruptured at one point from which emerged a cord attached to a fetus about 9 cm. long; the other end of the cord was attached to a mass of placental tissue about 5 cm. in diameter. There was considerable fresh bleeding from the open tube. Tube was clamped at its proximal end, vessels ligated and divided. There was free bleeding in the form of oozing from the site of the placenta. This could only be controlled by packing with gauze. In freeing the distal end of the tube the ligature was put around a mass of tissue in which, after the tube was amputated, what appeared to be the cut end of the right ureter was visible. At this time patient's condition was so serious that no attempt could be made to repair the ureter. Proximal end was brought down and sutured to the extreme head of the distal end. Rubber

dam drain was placed down to the end of the ureter. Two gauze packs were left in place to control hemorrhage. Wound was quickly closed in layers and the skin with interrupted silk worm gut."

Patient's condition at the end of operation was poor. Patient's blood pressure immediately prior to operation was 94/50

### *Pathologist's Report:*

*Gross:* The specimen consists of an irregular and nodular tube adherent to its associated ovary and having firm thickened walls. There is also an embryo 5 cm. long.

*Microscopic:* Sections show a chronic non-specific inflammation of tube and ovary.

*Diagnosis:* Salpingitis, chronic. Oophoritis, chronic. Embryo.

The immediate postoperative convalescence was very stormy and considerable stimulation was necessary.

The patient was first seen in consultation by the writer on January 3, 1930 at which time cystoscopy and urography were requested. The patient presented a healing, slightly infected wound in the right midline from which a small amount of urine was oozing. Upon questioning the interns and nurses, the impression was gained that the dressings did not contain the entire output of urine from the right kidney and that at least a fair percentage of urine from this kidney was finding its way to the bladder. In view of these findings, it was felt that any ureteral instrumentation at this time would disturb whatever ureteral anastomosis was in progress. The daily fluid intake and output were recorded and it was observed that the percentage of the latter was constantly increasing. The wound continued to heal and decrease in size and on February 10 was entirely healed and dry.

Cystoscopy was done on February 18, as follows: Usual preparation. There was some obstruction to the passage of the cystoscope due to constriction of the urethra. Bladder mucosa and landmarks normal with the excep-

\* From the Urological Service of Grasslands Hospital. Read before the Genito-Urinary Section of the New York Academy of Medicine, May 21, 1930.

tion of pouting at each orifice at the time of efflux. A No. 6 catheter passed to the left kidney pelvis without obstruction. On the

of the right catheter is seen on a level with the transverse process of the fourth lumbar vertebra. After the injection of contrast



FIG. 1. Pyelogram of right kidney (Feb. 8, 1930) showing lead catheter on level of fourth lumbar vertebrae and marked hydronephrosis of right kidney.



FIG. 2. Right ureterogram showing alternate constriction, dilatation and kinks with right angle kink and hairline outline of ureter over transverse process of fifth lumbar vertebra, where anastomosis probably occurred.

right side there was a definite obstruction at the junction of the middle and upper third and the catheter would pass no further. Sterile specimens collected from bladder and both kidneys for urea and microscopic examination. One cubic centimeter phenolsulphonephthalein intravenously appeared on the right side in five and one-half minutes and on the left side in and four one-half minutes. Pyelogram and ureterogram done on the right side.

#### Laboratory Findings:

	Bladder	Right kidney	Left kidney
Feb. 19, 1930			
Urea.....		.0048	.0063
Micro.....	Occ. pus cell	Few pus cells	Few pus cells
	Occ. epithelial	Few epithelial	Few epithelial
Stained preparation	No organisms	No organisms	No organisms
Culture.....	Sterile	Sterile	Sterile
P. S. P.....		12 c.c.	15 c.c.
		No P. S. P.	3 per cent P. S. P.

Radiographic examination of the urinary tract shows opaque catheters in situ. The tip

material in the right side, the major calyces of the right kidney appear considerably dilated as does the upper portion of the ureter contiguous to the pelvis. Contrast substance is seen in what appears to be the right ureter which structure is dilated and shows numerous kinks.

The patient insisted on leaving the hospital before dilatation of the right ureter could be accomplished and the social service department was unable to locate her subsequently.

#### CONCLUSIONS

1. The present picture of a markedly hydronephrosed almost functionless right kidney with constrictions and kinks of the right ureter may have been present, to some degree, prior to operation because of pressure from salpingitis and ectopic pregnancy.

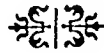
2. The extremely poor condition of patient at time of operation precluded any attempt to repair ureter at that time.

3. The partial ureteral anastomosis which had apparently taken place when patient was first seen by the writer, contraindicated any surgical procedure or intraureteral instrumentation at that time.

4. A conservative attitude of watchful

waiting was well rewarded with this patient.

5. The degree of ureteral constriction at the site of anastomosis is perhaps no greater than the amount which would have resulted from surgical repair.



## BENIGN TUMORS OF THE HEPATIC FLEXURE\*

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HAVANA, CUBA

THE following case presents considerable interest because of the rarity of benign tumors in the colon and

family history of this patient lacks importance. Aside from the eruptive diseases of childhood, the patient has suffered from malaria and



FIG. 1. Twelve hours after opaque meal, showing large filling defect in hepatic flexure of colon.

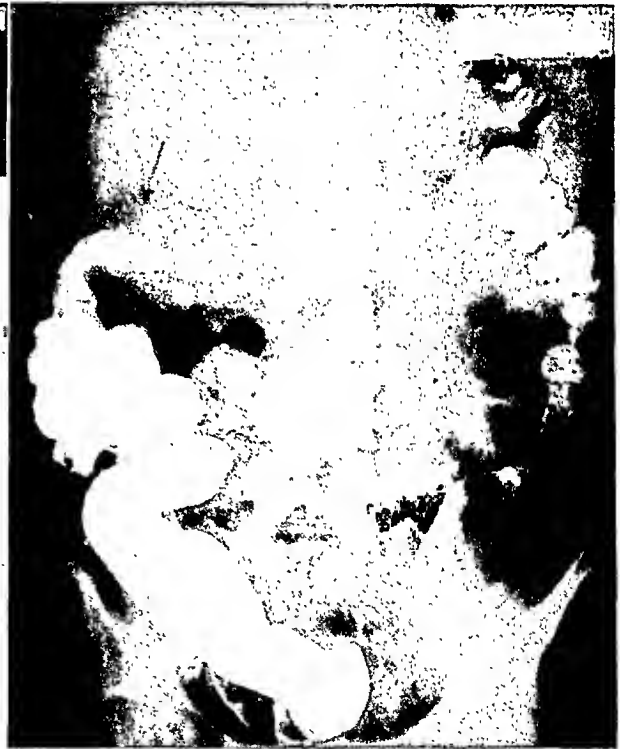


FIG. 2. Twenty-four hours following opaque meal. Note small intestine is not yet empty.

especially because of the difficulty of differential diagnosis in this instance.

### CASE HISTORY

On April 26, 1930, there entered the surgical service of the Canaria Association of Cuba under the care of Professor Duplessis, Mr. R. S., forty-six years of age, white, married. The

gonorrhea. In 1923 he was operated on for appendicitis.

Several months before entering the hospital he commenced to suffer from painful crises in the right upper quadrant, with obstinate constipation, for the relief of which the patient used purgatives and laxatives. His weight fell off slightly.

\* Submitted for publication October 16, 1930.



FIG. 3. Filling defect shown by enema.



FIG. 4. Same defect shown following attempt to evacuate barium enema.



FIG. 5. Photograph of the specimen removed.



FIG. 6. Photomicrograph of specimen, reported by the pathologist, Professor Ramirez Coria, as indicating benign lesion.

The cause of his entry into the hospital was an acute crisis with abdominal distension, meteorism, pain on palpation and fever, all these symptoms indicating an intestinal obstruction. This was relieved by ice bags, hydric diet and rest. As soon as the patient commenced to eat again, the picture of obstruction was repeated, presenting the syndrome of Czenick. The patient felt that gases on reaching the hepatic flexure of the colon were detained and passed backward toward the cecum, until after various attempts the gas boluses did pass with a gurgling noise.

On examining the abdomen by palpation there was noted a zone of resistance in the right upper quadrant, with marked pain on pressure. The examination of the urine and fecal matter gave normal findings. Wassermann and Von Pirquet reactions were negative.

*X-Ray Report:* Signs of intestinal obstruction due to an intrinsic tumor of the hepatic flexure of the colon. A number of roentgenograms were made following introduction of opaque material by mouth and by enema: the first at twelve hours, the second at twenty-four hours, the third by enema and the fourth following the first evacuation after the enema.

In view of the findings of the x-ray study and of the clinical examination carried out by the surgeon, operative intervention was decided upon. A hemicolectomy was done in one stage.

*Pathological Report:* The resected specimen was sent to the Laboratory of Pathological Anatomy of Professor Ramirez Coria, who gave the following report:

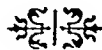
"Segment of colon surgically removed. The organ was received without opening it; so it was possible to determine that one of the ends

gave the impression of normal conditions as to thickness of wall, lumen, etc. The other end, on the contrary, showed very thickened walls, the lumen of which was almost completely abolished. A longitudinal section made to observe the interior of the intestine showed that in the segment where the lumen was obstructed the appearance of the mucosa was roughened, full of fissures and excrescences, marked with detritus and mucus. The consistency of these excrescences was fragile. Histological study made at various points showed that the general lesion, which attacked almost equally the whole extent of the organ in its diseased portion, was a papilloid proliferation of epithelium and of the connective tissue, with abundant atypical calciform elements. Between these formations there were observed ulcers, with mucoid necrotic base, invading even to the muscular coat. The remainder of the wall seemed full of miliary foci of infiltration with round cells and mononuclear and polymorphonuclear leucocytes.

There were no signs of malignancy," (Figs. 5 and 6).

#### CONCLUSION

At times the interpretation of tumors of the hepatic flexure is made difficult from the standpoint of deciding as to their nature. In spite of the carcinomatous aspect of this tumor from the standpoint of the roentgen findings, we refrained from making a diagnosis of carcinoma, limiting ourselves to calling attention to the presence of a tumor of intrinsic origin, without specifying this origin as benign or malignant.



# BENIGN PAPILLOMA OF THE RENAL PELVIS\*

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NEW YORK

**A**D. an Italian, aged sixty-two, occupation, carpenter. Admitted to the Urological Department of the James Buchanan Brady Foundation on November 18, 1929, at which time he was complaining of pain in the left flank.

*Venereal Infection:* Denies infection.

*Present Illness:* Began one year ago with a dull aching pain located in the left costal vertebral angle from which it radiated to the left flank and to the left testicle. The pain was characterized as being sticking. The attacks are periodic and are occasionally accompanied by blood in the urine. Sometimes the pain was so severe that it was necessary for his family physician to give him morphine to relieve the pain. During the past few months the attacks have been more frequent and the pain has been more severe. He thinks that the blood has increased both in amount and in frequency. The last attack occurred one week ago at which time there was a large amount of blood in the urine. During this attack he had severe pain whenever he voided his urine. This caused him to go to a hospital for advice and treatment.

*Physical Examination:* Reveals a well-developed and well-nourished male of sixty-two years of age. The examination was normal with the following exceptions: There is tenderness in both flanks, but most marked in the left flank, especially towards the left costal vertebral angle. The prostate was slightly enlarged, elastic in consistency and not fixed.

*Cystoscopic Examination:* Usual preparation. Instrument passed without difficulty. Vesical fundus shows some general edema. Ureteral orifices normal. Vesical orifice shows marked edema. Catheters No. 6 French passed to the kidney pelvis on each side. Specimens collected, sent to the laboratory for culture, urea and microscopical examination. One cubic centimeter of phenolsulphonephthalein injected intravenously, appeared on the right side in four minutes; left side in five minutes. Total amount secreted ten minutes after appearance time, 6 per cent right side, 5 per cent left side.

X-rays taken before and after the injection of sodium iodide into the left kidney pelvis,

patient being in the prone and erect posture, catheter withdrawn in the erect posture and ureterogram taken. After the x-rays had been completed the catheter was reinserted and sodium iodide allowed to drain off kidney pelvis irrigated with sterile water.

*X-ray Examination:* Genitourinary tract. Right kidney shadow is small in size and in good position. Left kidney shadow is large in size and gives one the impression that is about twice the size of the right kidney. There is no shadow indicative of stone in the urinary tract. Left pyelogram shows a filling defect which is quite extensive. It is about the size of the terminal phalanx of the thumb. The calices are not badly distorted. The pelvis is enlarged to about three times the usual size. There is a distortion of the ureter opposite the fifth sacral foramen.

*Impression:* The left kidney is the site of a papillomatous tumor intruding into the left kidney pelvis.

*Suggestion:* That the left kidney be removed under regional anesthesia.

*Operation:* Performed under paravertebral anesthesia on November 19, 1929. Usual lumbar incision was made through the superficial fat, extending through the abdominal muscles and fascia, exposing the peritoneum. The peritoneum was pushed upward towards the midline and the incision extended slightly downwards and forwards. The perirenal tissues were grasped with forceps and separated between the forceps exposing the surface of the kidney. The kidney was freed from the surrounding tissues by blunt dissection. When the pelvis of the kidney was exposed, a soft resilient mass was palpated in the kidney pelvis. This mass was freely movable in the kidney pelvis. In view of the findings of the pyelogram, the pelvis was not opened and a nephrectomy was done. Kidney pedicle doubly ligated in the usual manner. Closure with plain catgut, rubber tissue drain from the upper angle of the wound which was closed in layers. Dry dressing, patient returned to the ward in good condition.

The wound healed satisfactorily and was entirely closed at the end of two weeks.

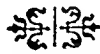
\* Read before the Genito-Urinary Section of the New York Association of Medicine, May 21, 1930.

During his stay in the hospital his convalescence was uncomplicated, and he was discharged from the hospital, as cured two weeks after operation.

*Pathological Report:* The gross specimen consists of a kidney about normal size. It measures  $11 \times 5.5 \times 4.5$  cm. in size. It is firm in consistency. The capsule strips with difficulty. The pelvis and attached 3 cm. of ureter are dilated apparently by pyelography. There is no obvious inflammation. On incision of the pelvis it is found to be filled with a soft papillary growth of which no point of attachment is found in this incision. When the kidney substance is cut through the point of attachment is found to be by a broad base at the brim of the pelvis. Microscopic section shows numerous villi of loosely connected tissue covered by a many-layered epithelium, composed of ovoid cells which are regular in size and shape. The

loose connective tissue stalks are infiltrated with round and polynuclear cells. No mitoses are found. There is no evidence of any infiltration whatever at the base of the growth, although the base is included in this section. In view of this and also of the regularity of the cells, we believe the process to be entirely benign.

Patient was last seen on May 19, 1930, at which time he was free from symptoms and was enjoying the best of health. Cystoscopic examination reveals that the vesical fundus is normal in appearance; there is no evidence of tumor, stone or diverticulum. Left ureteral orifice is open, golf-hole in type and there is a ureterocele at the lower border of the ureter which remains constant as long as there is pressure in the bladder. The lower end of the right ureter was apparently within normal limits.



## TRAUMATIC AVULSION OF THE TIBIAL TUBERCLE

REPORT OF A CASE SHOWING HEALING BY FIBROUS UNION\*

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ERIE, PA.

**T**RAUMATIC avulsion of the tubercle of the tibia is a distinct clinical entity. After a search of the literature one is struck by the paucity of cases recorded in both American and foreign journals. Cotton<sup>1</sup> points out the rare occurrence of this injury in adults. This condition must be differentiated from the sprain described by Osgood and Schlatter and since known as Osgood-Schlatter disease, a process of gradual onset, occurring most frequently during the age of adolescence and characterized by swelling, tenderness and pain in the region of the tubercle of the tibia. Grossman<sup>2</sup> and others have pointed out that this condition is somewhat analogous to Perthes' disease.

Ossification of the epiphysis of the tibial tubercle takes place most frequently between the twelfth and the fifteenth year. Complete bony union between the epi-

physis and the shaft of the tibia does not occur until about the eighteenth year. Rickets predisposes to separation of this process. Trauma, direct and indirect, of varying forces may produce this condition on account of the exposure of the tubercle to these forces.

Avulsion of the tibial tubercle may be the result of direct violence, as in a case reported by Overlock<sup>3</sup> in which the patient sustained a blow just below this process from the hoof of a horse; or as a result of violent contraction of the rectus femoris which apparently was the *modus operandi* in the case which is reported in this article. The history and physical signs should aid the examiner in making the diagnosis. The patient, as in this case, stepping downward from sidewalk to street, with the weight of the body thrown forward, suddenly loses his balance, and

\* Presented before the Staff of Hamot Hospital, Erie, Pennsylvania, October 8, 1929.



in attempting to regain his poise, extends the leg forcibly upon the thigh bringing into play a marked contraction of the

giving one the impression of an effusion into the joint. Aside from this, there is no deformity. There was exquisite tenderness

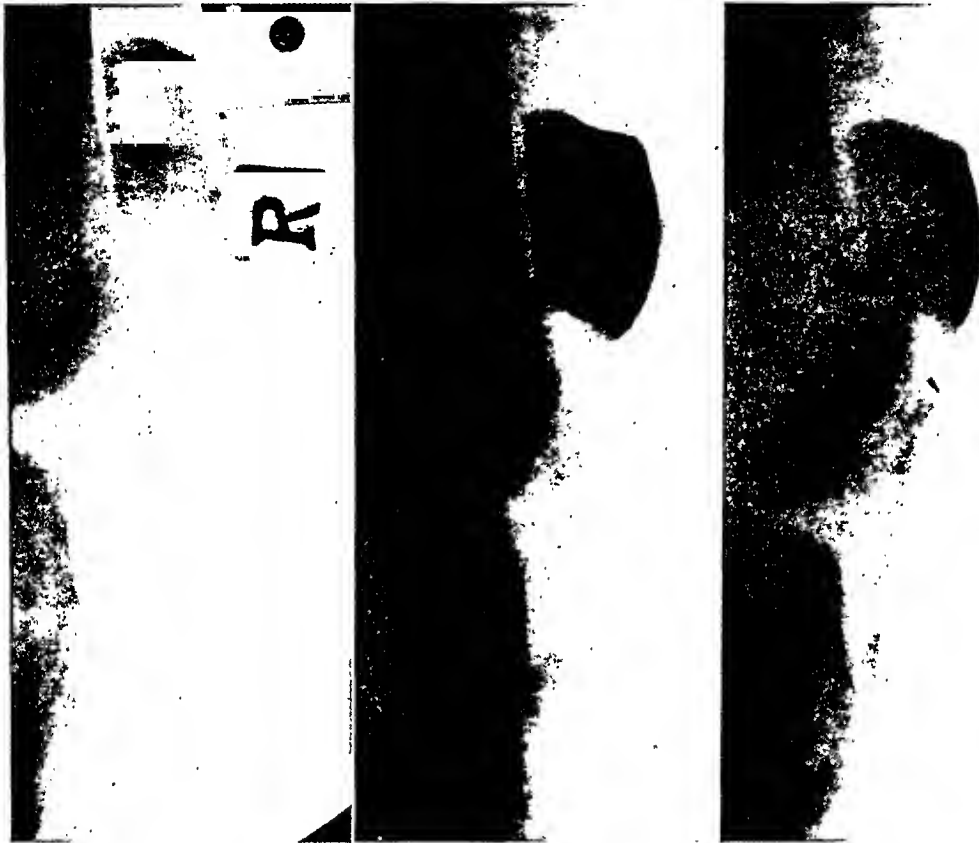


FIG. 1.

FIG. 2.

FIG. 3.

FIG. 1. Dec. 24, 1928. An irregular  $\frac{1}{4}$  by 1 in. piece of bone has been pulled off the anterior tubercle of the upper end of the tibia. This is separated about  $2\frac{1}{2}$  in.

FIG. 2. Dec. 14, 1929. Old fracture of tubercle of tibia, which is in good position. Bony union appears to be present between fragment and shaft.

FIG. 3. Jan. 18, 1929. Small piece of bone, which appeared to be attached to tubercle of tibia, now appears to be loose and ununited.

rectus femoris. As a result of the quick tearing of the tubercle from the bone, plus the loss of equilibrium, the patient falls and upon attempting to rise finds that it is impossible for him to extend his leg except by very extreme effort and then only with much pain. Subsequent pain is present only upon movement of the affected part and as soon as the limb is immobilized the patient is comfortable. Disability is limited to extension which can be done only upon extreme exertion, the non-affected vasti being brought into use. The swelling in this case was considerable, the knee being puffed out,

in the case reported by the writer, the patient objecting very strongly to even light palpation.

*Treatment:* If there is not too much retraction of the patellar ligament, as shown by x-ray examination, and if the tubercle can be palpated and replaced, strapping and immobilization may effect a complete cure. If, however, retraction is great and swelling considerable, as in the case reported later, it is the writer's opinion that operative measures are then justified.

*Prognosis:* Good results have been reported by both methods after three

months. Untreated cases suffer much lameness.

This case is presented, first, because of

*Present Illness:* About 11 P.M., on the evening of December 21, 1928, the patient, while stepping from the sidewalk to the street, lost

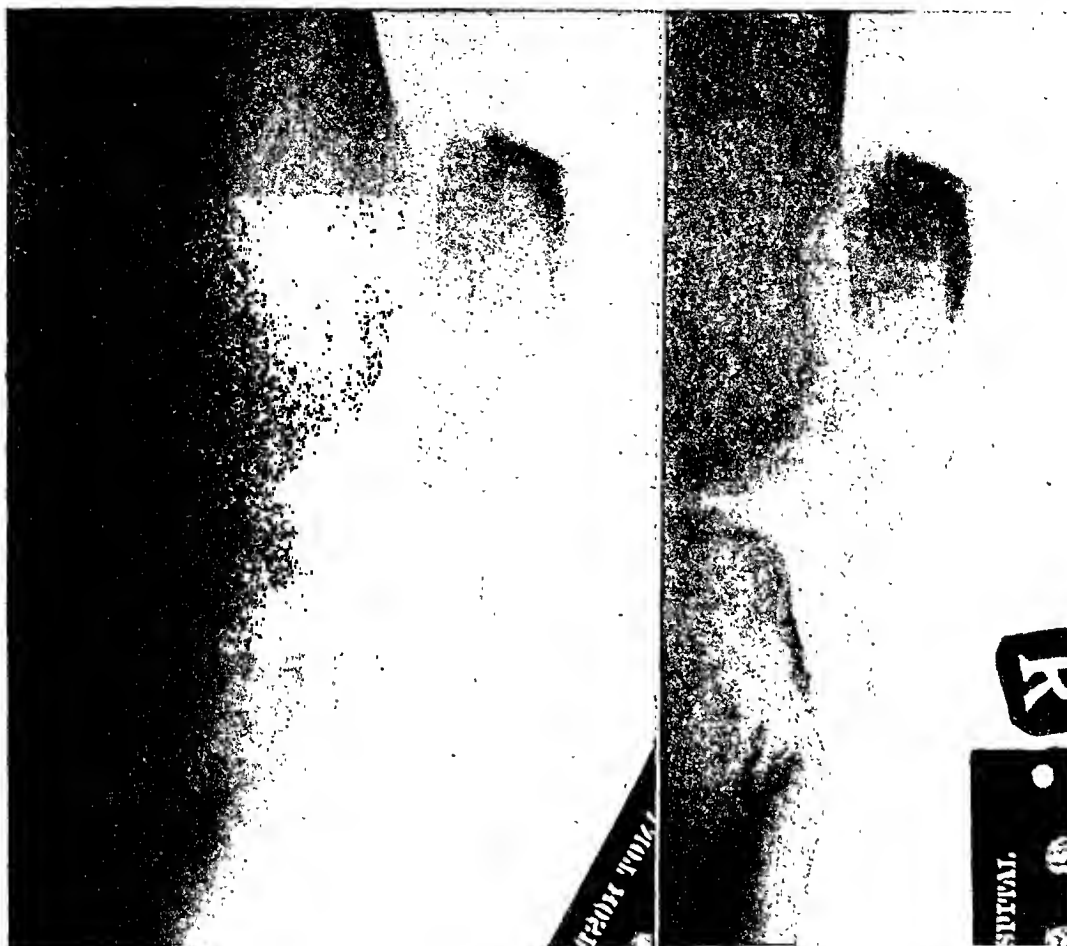


FIG. 4.

FIG. 4. Feb. 18, 1929. Tibial tubercle is not united, and appears to be absorbing. Calcified material is seen in infrapatellar region, and in soft parts along posterior part of lower end of femur; the latter is probably calcification in the vessels.

FIG. 5.

FIG. 5. June 22, 1929. Numerous loose pieces of bone or calcareous material seen in infrapatellar region, indicating non-union.

the rarity with which these cases are seen; second, because of the age of the patient and the excellent recovery he made (it seems that this is the oldest patient on record to sustain such an accident); and, third, because of the changes which occurred in the avulsed tubercle which in no wise affected the functional result.

#### CASE HISTORY

I. S., aged seventy, attorney, married, wife and three adult children alive and well. No previous history of bone disease. This patient has always been in good health and is still active in his work.

his balance, tried to regain his poise, but fell into the gutter. He was dazed for a few moments, but rapidly recovered and was able to call a passer-by for help. He was carried to his hotel across the street and put to bed. This accident having occurred in a city over a hundred miles away, it was impossible to see the patient before the following day. Owing to his desire to return to his home, a cast was applied from the toes to the groin and the patient was transported to Hamot Hospital, Erie, Pa.

*General physical examination* showed nothing of interest aside from the local condition complained of except bilateral, indirect, incomplete, inguinal herniae which were held in place by a truss. The patient has worn this

device for many years with comfort and freedom from symptoms.

**Local Condition.** The patient complained of pain in his right leg upon the slightest motion. Function was lost. Measurement of the lower extremity from anterior superior spine to the internal malleolus showed no shortening. There was neither outward nor inward rotation of the thigh or leg. The knee was swollen very considerably but showed no discoloration. There was exquisite tenderness over the entire knee and further examination was so painful that it had to be abandoned. The patella could be palpated and appeared to be intact. The swelling was so great that it was assumed that there was a considerable effusion into the joint. Again, owing to the swelling and pain, it was impossible to determine further injury to the patella or its attachments.

X-ray examination revealed an avulsion of the tibial tubercle with some retraction of the patellar ligament and an upward displacement of the patella.

**Operation.** On December 24, 1928, the patient was given morphine sulphate grain  $\frac{1}{6}$  by hypodermic and barbitol grain 5, the leg having been prepared for operation. Under local anesthesia, using procaine 1 per cent, a field block infiltration of the knee was made after the method of Braun. Through an incision about 6 in. long, extending from just above the patella to a point just below the tibial tubercle, the site of fracture was exposed and found to be occupied by a large hematoma which was removed. The ligamentum patellae with its attached bony fragment was isolated and the tibial tubercle was united by No. 2 chromic interrupted sutures to the periosteum of the tibia. Several sutures of the same material were placed through the patellar ligament into the periosteum of the tibia. A full-length cast was applied with the leg in extension and the patient was returned to bed.

**Postoperative Course.** The patient remained in the hospital for seventy-two days during which time his temperature, pulse and respiration remained normal. All clinical laboratory data were negative. The wound healed by

primary union. Twenty-eight days after operation (January 21, 1929) the upper half of the cast was removed and radiant heat was applied daily to the entire leg. The extensors of the thigh and leg were given light massage and a limited amount of active and passive motion. Two weeks later (February 5, 1929) the remaining half of the cast was removed and a posterior Cabot wire splint was substituted. The patient then began to walk on crutches. Two weeks later (February 19, 1929) the splint was removed and the patient was able to walk with crutches having good extension and flexion without pain. He was discharged from the hospital on March 4, 1929. By April 1 he was able to walk without lameness and without assistance from either cane or crutch.

The roentgenogram showing the original injury is self-explanatory. The film exposed on January 14, 1929 is interesting in that the roentgenologist reported an old fracture of the tubercle of the tibia which was in good position and that the bony union appeared to be present between the fragments and the shaft. A month later, however, this fragment appeared to be loose and ununited. On March 18, 1929, or two weeks following his discharge from the hospital, the roentgenologist reported that the tubercle of the tibia was not united and appeared to be undergoing absorption. The last film made on June 22, 1929 showed practically no further change except possibly some additional absorption of the fragments, but, as in the preceding roentgenograms, the patellar ligament appeared to be united by fibrous union to the site of the fracture.

At the time this report is being written one year and five months following the injury, the patient has resumed his occupation and is able to walk about with no lameness and with no assistance. Flexion and extension of the leg on the thigh and of the thigh upon the abdomen are not limited in any degree.

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2. GROSSMAN, J. *M. J. & Rec.*, 121: 534 1925.
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# INFECTED PELVIC HEMATOCELE CONTAINING FETAL BONY ELEMENTS\*

HARVEY B. MATTHEWS, M.D.

BROOKLYN, N. Y.

MRS. A. H., No. 2499, was admitted to the Gynecological Service at the Long Island College Hospital with

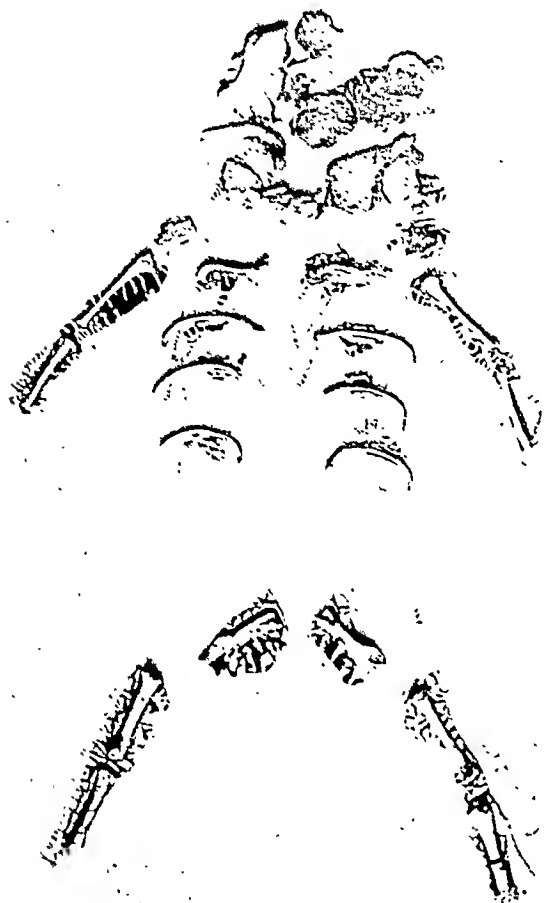


FIG. 1. Fetal bones removed from pelvic abscess and assembled to resemble true fetal skeleton. History of ease and stage of development of bones are about that of a four to four and one-half months' fetus.

the chief complaint of general debility, pain across the lower abdomen, and lumbosacral backache. She has been married ten years, was twenty-four years of age, Hungarian by birth and had three children, the youngest six years and the oldest eight years. She has had no miscarriages.

*Past and Family History:* She began to menstruate at the age of twelve years, regularly every twenty-eight days, five days' duration, using 4 to 6 napkins a day, no pain, no clots. After marriage there was no change in the menstrual history until one year before onset

of present illness when periods became irregular, coming on every two to three weeks and flowing from two to three days to as long as eighteen to twenty-one days and without pain. Last regular period was six months previous, followed by spotting for one month. The patient was curetted by her family physician for the relief of this spotting. Following the curettage there was no bleeding for two weeks. Then the patient began to bleed again and had a moderate amount of bloody discharge for seventeen days, during which time she had more or less fever. She was at this time sent to a hospital.

Excerpts from the record of the hospital to which she was admitted were as follows: Admission diagnosis was postabortal sepsis and pelvic cellulitis; temperature 101.6°F., pulse 120, respiration 24. Blood examination: White blood cells 27,800; polymorphonuclear cells 87 per cent. Temperature ranged from 99° to 102.2°F. for six days and then remained normal until discharge 12 days later. Pelvic examination at this time revealed a uterus the size of 4½ months' pregnancy, limited in mobility, no tenderness, moderate pelvic exudate.

Two weeks after discharge from the hospital the patient began to bleed again and continued to spot at irregular intervals for the next three weeks. Following this period there was no bleeding for eight weeks and then there appeared what the patient thought was a menstrual period in which she flowed about normal for two days, this being five months since the beginning of the present trouble. The pain in the right side and lumbar region had progressively grown more severe until at present these symptoms were quite disabling.

At this time, three and one-half months after her discharge from the former hospital, the patient was admitted to the Gynecological service of the Long Island College Hospital, complaining of general debility, severe lower abdominal pain and lumbosacral backache. She had lost considerable weight since the onset of her illness six months ago. Admission temperature was 99.6°F., pulse 120, respira-

\* Submitted for publication September 30, 1930.

tions 25. Blood count: Red cells 3,600,000, white blood cells 13,000, polymorphonuclear 75 per cent, small lymphocytes 17 per cent, large lymphocytes 10 per cent, hemoglobin 66 per cent, and blood pressure 122/70. Physical examination revealed a well developed, fairly well nourished, anemic, white female, who did not appear acutely ill. Head and neck negative and teeth in good condition. Tongue coated but moist. Lungs negative. Pulse 120, good quality. Abdomen slightly distended and moderately tender throughout. There was a mass reaching four fingers breadth above the pubis and extending across the lower abdomen, especially toward the right side which was hard in consistency, quite tender and not movable. Extremities negative. Pelvic examination disclosed a relaxed, lacerated pelvic floor, unilateral lacerations of the cervix, with moderate chronic endocervicitis. Cervix and uterus pushed forward and upward by a large fluctuating moderately tender mass filling the cul-de-sac and extending upward in the midline to four fingers above the symphysis pubis and up the right lateral wall of the pelvis almost to the level of the anterior superior spine. Diagnosis: Pelvic abscess following postabortal sepsis. Recommendation: Posterior colpotomy and drainage.

**Operation:** When the cul-de-sac of Douglas was opened, a large quantity of foul pus escaped, following which bony elements appeared. These were fished out and have been arranged to form almost a perfect fetal skeleton as may be seen in the illustration (Fig. 1). Drainage was established and the patient returned to her bed in good condition.

Convalescence was excellent. The highest temperature was 100.2°F., pulse 90 to 100 the first week, coming down to 80 during the second week. The patient was discharged on the twenty-first day after operation. Discharge examination: Relaxed pelvic floor, cervix points in axis of vagina and there is a slight right unilateral laceration and moderate chronic endocervicitis. Uterus ante-flexed and retroposed and is more or less fixed by a small non-sensitive exudate in the posterior and right lateral cul-de-sac of Douglas. There is considerable granulation tissue along the line of the healed posterior colpotomy incision. The general condition was satisfactory in every respect.

#### COMMENTS

The most interesting points in the study of this rather unusual case is the question of whether the uterus was punctured at the time of the curettage by her family physician (six months previously) through which the fetus (four to four and one-half months) was extruded into the cul-de-sac of Douglas. Here it became encysted and infected. Or was it an ectopic gestation that had developed four to four and one-half months before rupture or abortion took place? In the light of the history and operative findings we believe that it was an extra-uterine pregnancy which ruptured or aborted, without excessive bleeding, gravitated into the cul-de-sac of Douglas, became encysted and infected and later formed a pelvic abscess.



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## EDITORIALS

### THE AMERICAN JOURNAL OF SURGERY'S CONTRIBUTION TO RADIOLOGY IN 1930

IN retrospect the Editors and publisher feel considerable satisfaction in the part played by our publication in recording the radiologic advances of the year just closing. Nearly every year marks some important advance in the rapidly extending field of radiology; 1930 has been no exception, for it has witnessed the introduction of successful intravenous urography by Swick, von Lichtenberg and their co-workers, first published in English in these pages.

Another important step forward is the contribution of Saito and his colleagues on successful and useful blood-vessel visualization in the living, which in conjunction with the achievements of dos Santos in aortography opens the way for practical

clinical blood-vessel visualization in the diagnosis of injuries to blood vessels and in brain tumors while making renal tuberculosis discoverable at a still earlier stage.

In the field of gastroenterology 22 articles have appeared covering the entire alimentary tract and the gall bladder. In addition to the discussion of important fundamentals in gastrointestinal and gall-bladder radiology, special lesions have been studied, such as benign tumors of the stomach and intestine, gastric sarcoma, gastrocolic fistula, hernia into the lesser peritoneal cavity, differential diagnosis between peptic ulcer and chronic appendicitis, the detection of small intestinal adhesions, and a scholarly essay on the question of the chronic appendix (Maes).

Honk's article on the simulation of chronic appendicitis by other pathological conditions is especially valuable.

The lungs and upper respiratory tract have been considered in 12 papers, including discussions of the nasal sinuses, antral polypi, an ingenious device for lipiodol visualization of the bronchi, and a valuable assortment of beautifully illustrated papers on empyema, pleurisy, pulmonary abscess, mediastinal and subphrenic lesions, hernia of the diaphragm, and an important paper on apical chest tumors. Professor Belot of Paris contributes an excellent and timely paper on better protection in upright fluoroscopy.

In the genitourinary diagnostic field, in addition to the papers on intravenous urography by Swick and by Lubash, 19 papers cover uterosalpingography, urinary calculi, anomalies and operative damage to the ureters, renal cysts and tumors, foreign bodies in the urethra, diverticula of the bladder, and a new urographic medium. A valuable special article considers suppurative myositis of the iliopsoas muscle as stimulating renal pathology.

Bone and joint radiology is represented by 25 diagnostic articles besides several on radiation therapy. Papers on fractures and dislocations cover the entire spine, pelvis and extremities, and there are discussions of pathological fractures in primary bone tumors of the extremities, tumors of the thoracic cage, tumor of the pubis, congenital bone lesions, fluoroscopic control of fracture surgery, and several

articles on spondylitis. Moodie's studies in paleopathology contain much material of value to the radiologist. Of no small importance is the masterly discussion by Illievitz on fractures in relation to disability.

Twenty-five other articles discuss a variety of subjects: radiological aspects of some neuromata; radiotherapy of syringomyelia, bone tumors, malignant granulomata, alimentary tract carcinoma, benign and malignant genitourinary tract disease; foreign bodies in the brain and elsewhere and methods of removal; a complete treatise on obstetrical measurements and the localization of pulmonary lesions; a valuable paper on the embryological development of bone. Four contributions on roentgenology in hospitals and medical schools have special reference to the teaching of this subject. Diocles' dissertation on telestereoroentgenography tells all there is to be known about the principles of stereography and their application to x-ray diagnosis.

Thus, in a journal devoted to surgery and its allied sciences, there have been published more than 100 communications of direct interest both to the surgeons and radiologists. As has been emphasized several times in these pages, the radiologist should preserve his usefulness as a clinician by participating broadly in the study of surgical lesions, and should seek to keep abreast of the progress of surgery in order to render the fullest measure of service in his diagnostic and therapeutic work.

JAMES T. CASE.



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*P. M. Hickey*

[1865-1930]

The American Journal of Surgery  
N. S. Vol. x, December, 1930

⊕ PRESTON M. HICKEY 1865-1930 ⊕

IT is with a profound sense of irreparable loss that we record the passing of one of America's ablest radiologists in the death of Preston Mannaseh Hickey, Professor of Roentgenology at the Medical School of the University of Michigan.

The sterling honesty, friendliness, loyalty and patience of his gentle nature endeared him to all who came within the sphere of his beneficent influence, so that he was widely loved and respected, most of all by those who had the good fortune to be numbered among his students. He will be greatly missed by the various radiological organizations to which he contributed so much as well as by the numerous other medical bodies of which he was a valued member.

Dr. Hickey received his A.B. degree from the University of Michigan in 1888 and in 1892 his medical degree from the Detroit College of Medicine with which institution he maintained active teaching connection until his removal to Ann Arbor in 1922. At first a teacher of pathology, he gradually worked into clinical medicine as a laryngologist, which he continued to practice until after the War after which he devoted himself entirely to radiology. His radiological experience, however, began shortly after the publication of Roentgen's discovery, with such success that by 1899 he was already doing fracture radiology. His interest, begun thus early, continued with increasing results all the rest of his life, his contributions covering especially the nasal accessory sinuses, the mastoids,

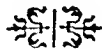
and the lungs. As a laryngologist, he was able to make pioneer contributions to the localization and bronchoscopic extraction of swallowed and inhaled foreign bodies.

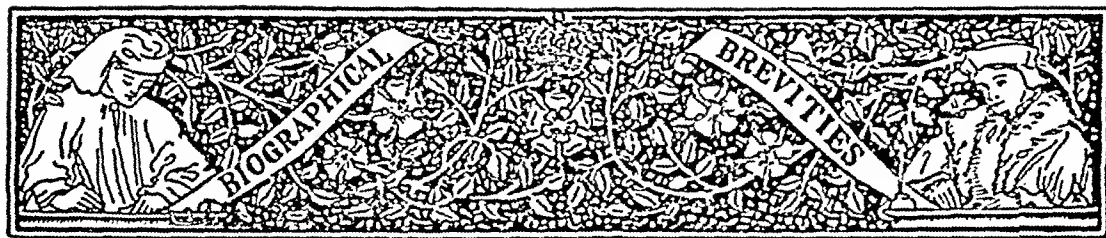
In a literary way Dr. Hickey's outstanding contribution to radiology was the founding of the American Quarterly of Roentgenology, later known as the American Journal of Roentgenology, which he edited for many years.

One of the first to respond to the call to arms in 1917, Dr. Hickey assisted in the organization of Base Hospital #17, the Harper Hospital Unit from Detroit, going overseas with this group in July of 1917. The writer, as Director of Roentgenology for the American Expeditionary Forces, recognized immediately how much more helpful Dr. Hickey could be at general headquarters than in a hospital unit, and, with the reluctant consent of Col. McLean and his associates of Base Hospital #17, Major Hickey was transferred to assist in the organization and direction of the x-ray service of the A. E. F. Once more the writer is proud to acknowledge the valuable help and the delightful comradeship so freely given him by Doctor Hickey during 1917 and 1918 in France.

So, in this hour of separation from a beloved colleague, we are glad of this opportunity to pay a formal tribute to Preston M. Hickey, scientific, accurate, patriotic, progressive, painstaking and untiring, broad, kindly, sympathetic, and always intensely human.

JAMES T. CASE.





## "TRENDELENBURG POSITION"

**H**OW often does the surgeon order a patient in the "Trendelenburg position"? In shock and other conditions it is still a routine part of the treatment.

Friedrich Trendelenburg lived and worked in the time of the present generation of physicians. He was born on May 24, 1844 in Berlin. His early education was at the feet of his mother and father. His mother taught him English, his father, Latin and arithmetic, while an aunt drilled the youth in grammar. Eventually he attended a boys' school in Berlin. Later, he was given the choice of going to a boarding school in Berlin or to Scotland with his family for a year. He went to Scotland and while there studied anatomy, embryology and physics. In 1864 he took his preliminary medical examinations and in 1866 was given his medical degree.

His positions were many. He was a military surgeon. He wrote a thesis on Ancient Indian Surgery. He was appointed an assistant to Langenbeck. He founded the German Society of Surgeons. In 1874, he was made a director of the surgical ward at the Friedrichschain Hospital in Berlin. In order, he became Ordinarius in Surgery at the Universities of Ristock, Bonn and Leipzig. He was at one time Chairman of the German Society of Sur-

geons and, at the time of his death, its historian.

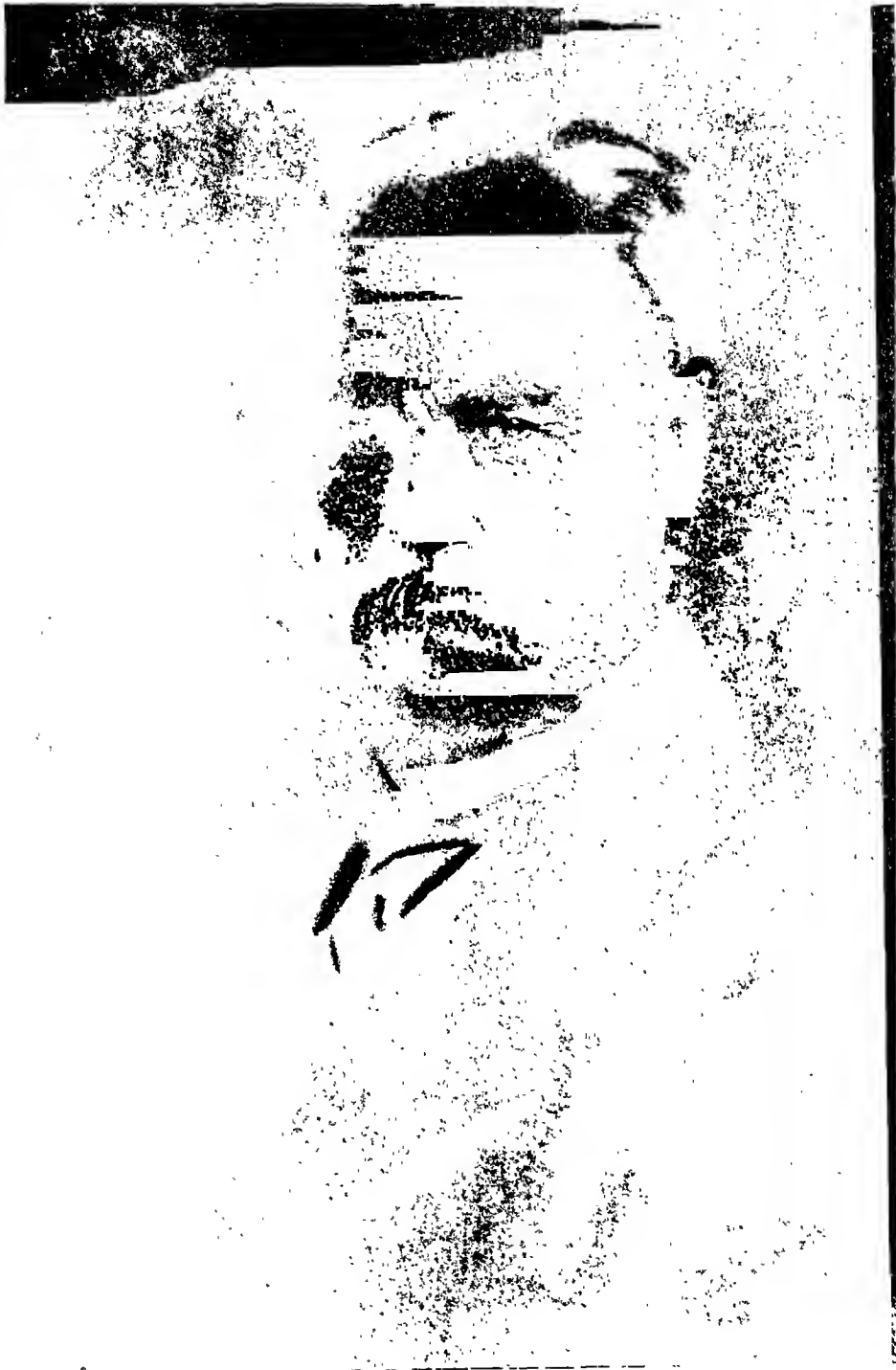
Trendelenburg wrote many important papers. He did exceptionally splendid work in the field of plastic surgery, congenital hip-joint diseases, pulmonary embolism, and in the physiology of varicose veins. His work in the restricted limits of gynecology and abdominal surgery was such that his name is listed among the surgical immortals.

It is interesting to note that Willy Meyer of New York was the first to record the Trendelenburg position. Meyer was at the time a student of Trendelenburg and published the description with the permission of his "venerable chief." Two weeks ago the writer sat across a luncheon table from Doctor Meyer, who forty-five years ago was a student under Trendelenburg. What a privilege! One day we must get Doctor Meyer to write of his student days in Germany.

Originally the position was tried as a means of introducing air into the open bladder following the "principle of Sims' posture where the vulva is the most elevated point of the body and the opened vagina admits air because of negative intrapelvic pressure and thus becomes distended."

On December 15, 1924 in his eighty-first year, Trendelenburg died. T. S. W.





*F. Trendelenburg.*

[1844-1924]





[From Fernelius' *Universa Medicina*, Geneva, 1679.]

# BOOKSHELF BROWSING

STUDIES IN PALEOPATHOLOGY, XXVIII

## THE PHENOMENON OF SACRALIZATION IN THE PLEISTOCENE SABRE-TOOTH

ROY L. MOODIE, PH.D.

SANTA MONICA, CALIF.

THE anomalous phenomenon of the exaggerated development of the transverse processes of the last sacrum is obvious. The relation of this

ature as sacralization. That this may be accompanied by co-ossification with the sacrum is obvious. The relation of this

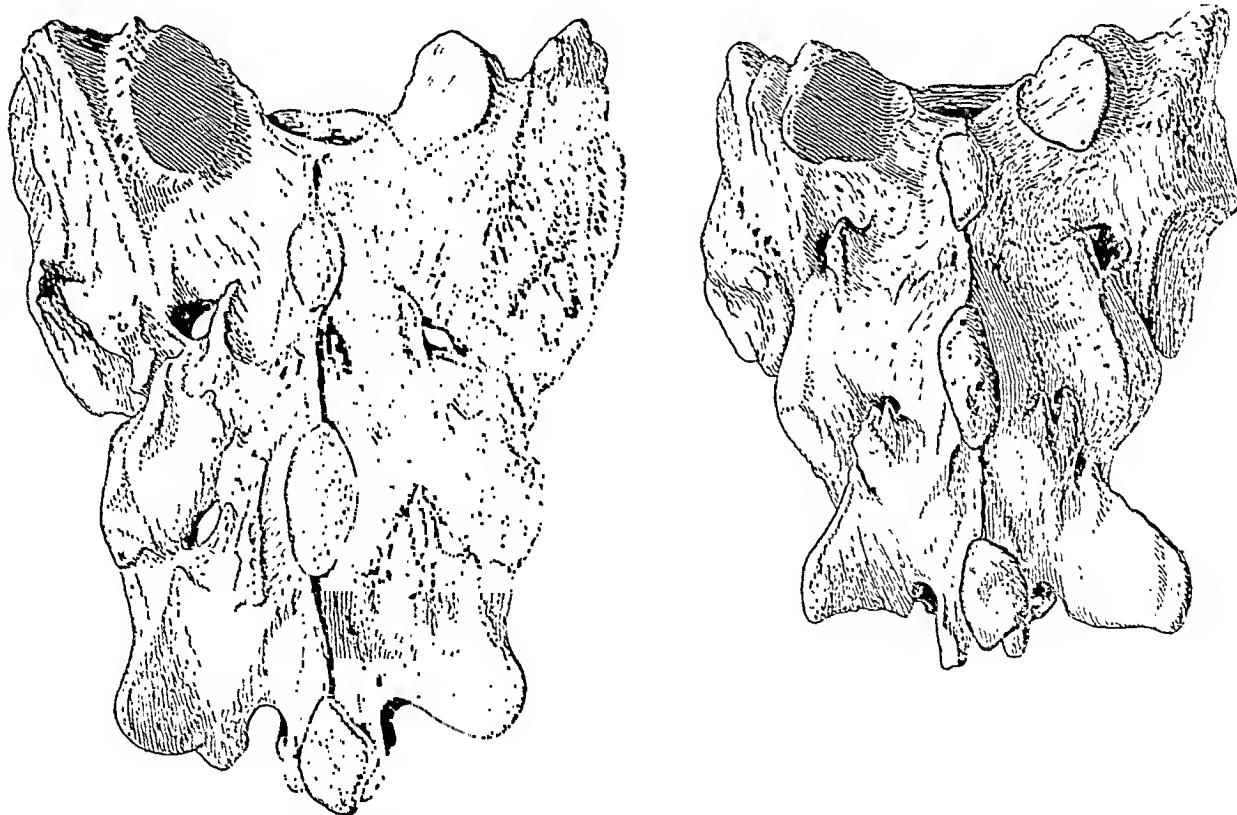


FIG. 1. Two normal sacra of the sabre-tooth, showing differences in two adults, possibly male (left) and female (right). The left sacrum has a length of 150 mm.; the right measures 122 mm. The dorsal view shows the complete union of the three vertebral units to form the sacrum. This union takes place relatively early in life.

lumbar vertebra until they look like parts of the sacrum is known in medical literature, often seen in roentgenological examinations of the lumbosacral region, to

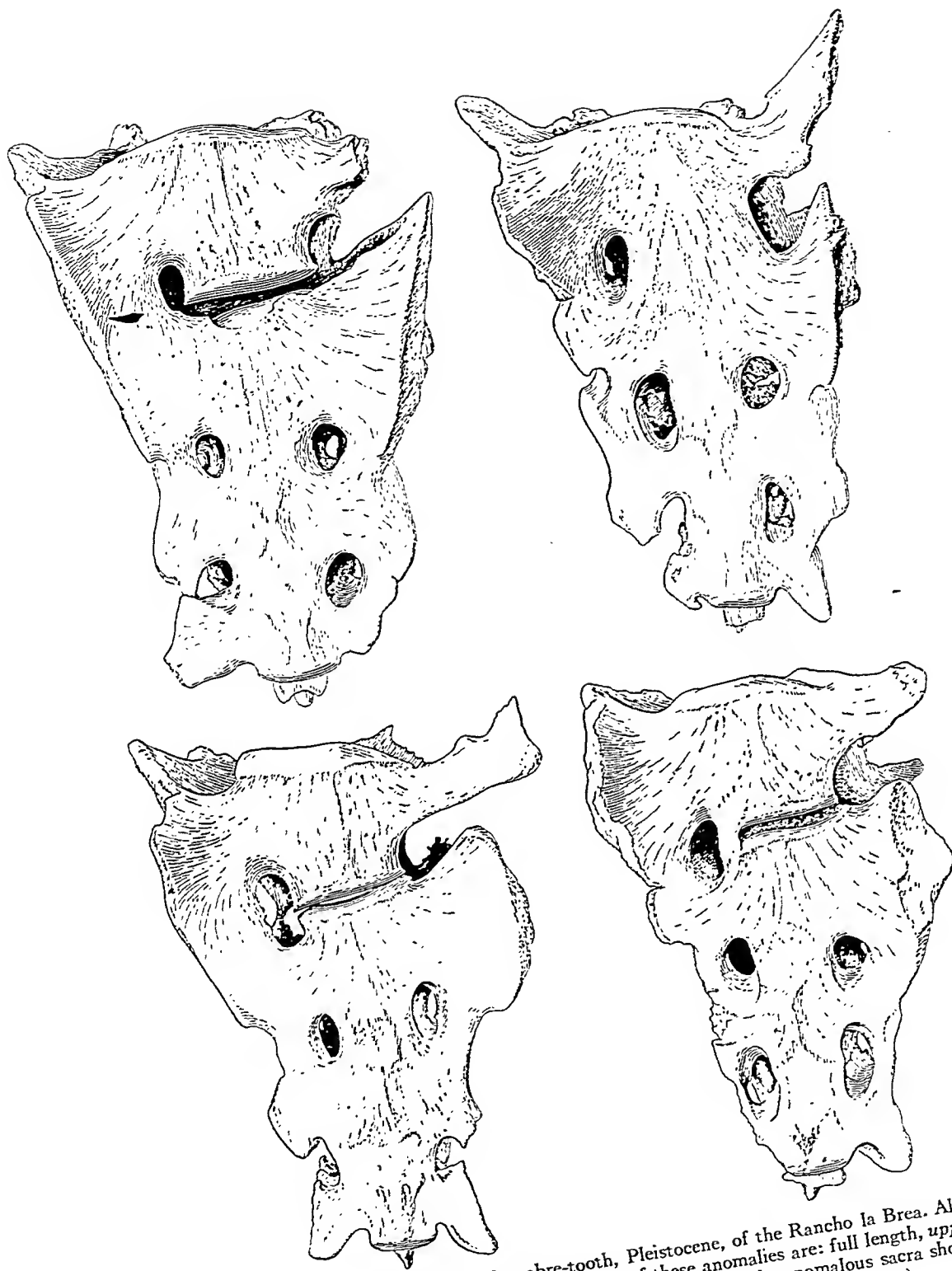


FIG. 2. Four examples of sacralization in the sabre-tooth, Pleistocene, of the Rancho la Brea. All co-ossifications are on the right side of the sacrum. The measurements of these anomalies are: full length, upper left, 180 mm.; lower left, 165 mm.; upper right, 166 mm.; lower right, 157 mm. All the anomalous sacra show a right lateral curvature, some more pronounced than others. (Specimens in the Los Angeles Museum.)

lumbosacral pain has attracted some attention among medical men. The anomaly creates disturbances in the lumbosacral passages of nerves and blood vessels, which may cause pain.

The phenomenon has never been described in vertebrates other than man, so far as the writer knows, and the presence of five undoubted examples of this condition among the 1034 young and adult sacra of the sabre-tooth (*Smilodon californicus*) of the Rancho la Brea preserved in the Los Angeles Museum, Exposition Park, has led to this brief description of the phenomenon.

The five examples all show co-ossification on the right resulting in an asymmetry, with a lateral curvature to the right. Three of them were secured from Pit 3; one from Pit 60 and one from Pit 61. They are all apparently adult.

The sacrum shown in Figure 2, *upper left*, presents a reduction in size of the upper foramen, and a curvature to the right brought about by the intense co-ossification of the transverse processes. The articular surfaces on the right side have a length of 10 cm., and a width of 6 cm., including the surfaces of the co-ossified lumbar vertebrae; while the left articular surface offers dimensions of 7.5 cm. by 5.5 cm. The posterior zygapophyses of the lumbar vertebrae are not co-ossified with the sacrum, although the three normal sacral components are fused into a single mass.

The sacrum shown in Figure 2, *lower left*, is unusually slender, with a firm co-ossification of the right transverse processes, resulting in a marked asymmetry, with a

curvature to the right. The length of the right sacroiliac articular surfaces is 9 cm. with a width of 4.5 cm. The normal sacral elements are thoroughly co-ossified. The posterior lumbar zygapophyses are free. The left sacroiliac articulation measures 5 cm. by 5.5 cm.

Spondylitis deformans enters as a factor in the interpretation of the sacrum shown in Figure 2, *upper right*. This is due to the ossification of the entire mass of the ventral longitudinal ligament, which obliterates all trace of the intervertebral surfaces. The right sacroiliac articulation is very rough, measuring 9 cm. by 6.5 cm., while the left surface measures 5.5 cm. by 6 cm. The left transverse process of the lumbar vertebra is greatly roughened by disease. The sacral elements are united.

Still another condition is shown in the sacrum seen in Figure 2, *lower right*, in the ossification of a part of a longitudinal ligament, extending up quite a distance on the lumbar vertebra. The right articular surface measures 9 cm. by 5 cm. The left is pit-worn. Superiorly all traces of separate structures are obliterated.

The fifth example of sacralization shows co-ossification of transverse processes on the right, resulting in a slight asymmetry, with no traces of spondylitis deformans. The right sacroiliac junction measures 9 cm. by 4 cm., while the left shows almost equal measurements.

The phenomenon of sacralization in itself is not pathological, but an anomaly due to disturbance in growth, doubtless during early embryonic life. It is associated with diseased conditions without any definite relation to them.





## BOOK REVIEWS

CLIO MEDICA. A Series of Primers on the History of Medicine. Ed. by E. B. Krumbhaar, M.D., N. Y., Paul B. Hoeber, Inc., 1930. Vol. I. THE BEGINNINGS: EGYPT AND ASSYRIA, by Warren R. Dawson, F.R.S.E. Vol. II. MEDICINE IN THE BRITISH ISLES, by Sir D'Arcy Power, K.B.E. Vol. III. ANATOMY, by George W. Corner, M.D. Vol. IV. INTERNAL MEDICINE, by Sir Humphry Rolleston, Bart.

Probably at no time as at present has so much genuine interest been shown in the history of medicine. Physicians are curious to learn of their heritage. And although books and tracts without number have been published on the history of this branch of science only a minority of the profession have been sufficiently interested to add them to their libraries. Perhaps the fault may be divided between the authors and the publishers. However, in *Clio Medica* there is no excuse for all physicians not possessing these "primers" and mentally digesting the contents. In the first place, they are made to fit anyone's pocket. They may be read in two or three sittings. They are written by authorities in the various branches of medical historical lore. And they are written in a style that makes pleasant reading. Last, but not least, they are inexpensive. It is planned by the publishers to cover the entire field of medical history and before the series is finished the volumes will make an impressive array.

To date, Dr. Krumbhaar has done an excellent bit of editorial work. He has shown discrimination in choosing his authors. He has been fortunate in having men of such proven reputation do this work.

From the editor's preface we quote: "Since the times of Aldines and Elzevirs, small easily portable booklets have been popular with the intelligent reader. Today books that add no appreciable burden to the coat pocket are real helps to the busy worker or student in gaining ready access to considerable worthwhile reading . . . Conveniently small and inexpensive, yet prepared by recognized authorities in their chosen field, each volume will aim to present the story of some individualized phase of the history of medicine in such compact, connected, convincing and reasonably complete form that the medical undergraduate, the specialist, the

busy practitioner and the "intelligent layman" will be attracted to a few hours' reading, which in many cases will doubtless prove the introduction of an awakened interest to a more comprehensive study . . ."

To date we have before us, and have read and reread with true pleasure, *The Beginnings: Egypt and Assyria* by Warren R. Dawson, *Medicine in the British Isles* by Sir D'Arcy Power, *Anatomy* by George W. Corner, and *Internal Medicine* by Sir Humphry Rolleston. To follow shortly are: *Physiology* by John Fulton, and *Pathology* by A. S. Warthin.

All in all delightful. Whether or not a student of the history of medicine, if only for the sheer joy one will derive in the reading these little volumes may well be in every physician's possession.

THE STORY OF A SURGEON. By Sir John Bland-Sutton, Bt., F.R.C.S. With a Preamble by Rudyard Kipling. Illus. Boston, Houghton, Mifflin Co., 1930.

Few books are adorned by so choice a foreword as the "Preamble" with which Rudyard Kipling has graced this record of the life of his distinguished friend. Delightfully written in quaint odd English it bestows the title of "The Story of a Hospital" on the autobiography of a man much of whose life was given to the service of the Middlesex Hospital, with which institution his name will always be associated.

Bland-Sutton has been for so many years one of the best known surgeons and teachers of surgery in London that some of his many admirers in the United States will be amazed to learn of his many activities in other fields. As an anatomist, and especially as a comparative anatomist, his achievements have been somewhat overshadowed by his renown as a surgeon. Like his great prototype, John Hunter, he developed at an early age a veritable passion for the study of the anatomy of all living animals, and also their pathology. His many hours passed in the dissecting room at the London Zoo were far from wasted. Even his great work on "Tumors" probably owes much to these researches. In the course of his long life he has had not only many curious and interesting experiences but he has sought them out, and his brief recitals of his various travels in Africa, Egypt and Russia show how much a keen observer can glean from such journeyings.

Not the least interesting portions of the book are his anecdotes of the many distinguished persons with whom he has worked or been brought in contact. Entering the profession before the principles of antiseptics and asepsis had been established he has lived to see their triumph. He was active in the early days of gynecology, the days of Lawson Tait and Spencer Wells, and he was one of the chief factors in establishing that branch of surgery on a scientific basis. His reminiscences of Pasteur, Lister, Sir Frederick Treves, and other of the great men who were his older contemporaries are historic mementoes of great value.

The book is full of little asides on various subjects in natural history which are charming as the somewhat similar sketches of Frank Buckland or Gosse.

Lastly this is a modest autobiography. The many honors which have been conferred upon its Author are referred to in only the most casual manner, if at all. This book will be a solace to the older members of the profession and a stimulus to the younger.

FRANCIS R. PACKARD.

**EMERGENCY SURGERY.** By Hamilton Bailey, F.R.C.S. (Eng.) N. Y., William Wood and Co., 1930.

This is the first volume of a two volume work. It covers the abdomen and pelvis. We found it a valuable book. In the introduction the author considers sterilization, towels, abdominal pads, etc. Beginning in Chapter 2 he considers Laparotomy and in subsequent chapters deals with Peritonitis, Acute Appendicitis, Some Conditions Simulating Appendicitis, The Stomach, The Gall-Bladder and Bile Ducts, Other Emergency Conditions of the Upper Abdomen, Intra-Abdominal Injuries, Intestinal Obstruction, Intestinal Obstruction in the Newborn, Acute Intussusception, Strangulated External Hernia, The Female Generative Organs, The Rectum and Anus, Some Post-Operative Complications, The Kidney, The Bladder and Prostate, and The Urethra, Penis, and Testicle.

The illustrations are very good. Personally we got a great deal out of reading this book and are looking forward with interest to the second volume. It is a work every surgeon should have in his library.

**HISTORIC ARTIFICIAL LIMBS.** By Vittorio Putti, M.D. N. Y., Paul B. Hoeber, Inc., 1930.

This very delightful essay, first published under the Bookshelf Browsing section of THE AMERICAN JOURNAL OF SURGERY, is now issued in book form. The author offers the various phases of inventive advancement and those responsible for the progress made in the construction of artificial limbs. The book itself is a beautiful thing, the illustrations are well done, the author's style is engaging. To the orthopedic surgeon and anyone interested in the medical past and present this work will prove worthwhile.

**THE THEORY AND PRACTICE OF RADIOLOGY, With a Synopsis of Radiology and Radiotherapy. A Treatise in four volumes.** By Bernard J. Leggett, St. Louis, Mosby, 1930.

The author has undertaken a monumental work, and if the last volume, which has not yet appeared, comes out as satisfactorily as the three before, the work will be truly a monument not only to his industry but to his vision in foreseeing the need of such a publication.

*Volume I.* Volume One concerns "Electrical Theory Applied to Radiology." The volume is complete in 240 pages with an adequate index. At the end of each chapter is given a list of questions or exercises which are based upon analogous questions set in the examination at Cambridge for the Diploma of Radiology and Medical Electrolgy. The comprehensive knowledge of the theory and practice of radiology contemplated by these questions very highly recommend the courses leading up to this diploma. Volume One includes a discussion of mechanical units, the electric circuit, the magnetic current, varying currents, electromagnetic machinery, and the electron theory.

*Volume II.* Volume Two, entitled "The Physics and Measurement of X-Radiation," is slightly more voluminous than Volume One. There are over 300 pages on light and heat, the origin of x-radiation, x-radiation spectroscopy, properties of x-radiation (absorption, fluorescence, scattering, compression, refraction, luminescence, photo-chemical and photo-electric effects, polarisation), the measurement of quality of radiation, the measurement of intensity, the dangers of radiology and how to protect one from them. As in the preceding volume, each chapter is followed by a series of

exercises and questions based upon analagous questions set in the Cambridge examination for a Diploma of Medical Radiology and Electrology. The appendix to this volume contains a summary of the recommendations upon protection against x-ray and radium injuries, as they exist in England, Russia, Sweden, Germany and the United States of America. The French report is not included for the reason that at the time of the publication of this book this report was not available.

**Volume III.** Volume Three, of 550 pages, is devoted to "X-Ray Apparatus and Technology." From a practical diagnostic standpoint one doubts somewhat the advisability of printing such a volume of literature on apparatus, much of which is out of date; but from the pedagogic standpoint this information should be available in print. It is therefore included in this work in a very comprehensive manner. The author has apparently made the effort to bring into this book a complete description of the construction and management of all the different types of instruments made by all firms and in all countries. The localization of foreign bodies is discussed at length. There is a chapter on the radiological building which should be especially interesting to radiologists and hospital attendants who are interested in the construction of new housing for x-ray apparatus. Many technical details concerning the construction of protection apparatus in x-ray rooms are included in this chapter.

From the standpoint of the diagnostician we await with great interest the appearance of the fourth volume on "Diagnostic and Therapeutic Radiology." Twelve chapters are proposed, nine on diagnostic radiology and three on therapeutic radiology. If the last volume is done with the same comparative standard of completeness and thoroughness as characterizes the three preceding volumes, it will be a ponderous tome but so rich in information that every radiologist should feel obliged to possess it.

JAMES T. CASE.

**LABORATORY MEDICINE.** By Daniel Nicholson, M.D. Cloth, 437 pp. 109 illus. Phila., Lea & Febiger, 1930.

This volume presents a concise outline of the different procedures in clinical pathology useful to the practitioner of medicine with supplementary information on the normal ranges in various tests and other useful data.

It is a question however if a textbook for students such as this is, should depart from generally accepted views to voice personal opinion as it does in numerous places. For example the following are noted: "Never ask for both blood urea and non-protein nitrogen; they have the same significance." "Order uric acid only in cases of gout or suspected gout." "Ask for blood calcium determinations only in tetany of unknown origin." These instructions disregard not uncommon and often valuable other uses.

The following statement is found on page 65: "If there is a total leucocyte count over 25,000 with little or no fever and an enlarged spleen, a diagnosis of myeloid leukemia should be made." This is definitely misleading and contrary to established practice that no clinical diagnosis of myeloid leukemia is justified without a characteristic blood picture throughout. On the same page there is the following: "Bacillary infections do not produce an increase of the polymorphonuclear cells etc." It is only necessary to mention diphtheria.

On page 83, on the subject of blood grouping, it is stated that Moss 2 is the same as Jansky 2 and that Moss 3 is also the same as Jansky 2. This is evidently a misprint. The confusion apt to arise from the use of these various classifications is a serious matter at best, and particular care is imperative in the absolutely accurate preparation of chapters in books which deal with this subject.

FREDERIC E. SONDERN.

**A TEXT-BOOK OF GYNECOLOGY.** By Arthur Hale Curtis, M.D. Phila., W. B. Saunders Co., 1930.

In the inner conclaves of gynecologists it is admitted that Dr. Curtis has attained position among the first three ranking gynecologists in America. In recent years he has taken unto himself no little fame as a teacher of unusual parts and ability. With this reputation and background it is not amiss to say his book was awaited with interest. We have heard it criticized by lesser lights; but, upon reflection, their criticisms were devoted to minor points: too many illustrations for a certain operation; why does he start right off with Infectious Processes, etc. None we have heard is worth serious consideration. To us, it was delightful to open such a book and see missing the usual opening chapters on anatomy and physiology that one can, if he desires, get out of books

devoted to these subjects. Curtis has written a book that will appeal not only to gynecologists but, also, to the majority of the profession. He writes well. The reading makes one discern the invisible hand of the finished, seasoned teacher. There are 222 illustrations, chiefly by Tom Jones. All unnecessary material has been omitted and so the work is only 380 pages long. It is truly a work of merit.

**PRACTICAL TREATISE ON DISEASES OF THE DIGESTIVE SYSTEM.** By L. Winfield Kohn, M.D. Phila., F. A. Davis Co., 1930.

This treatise is done in two volumes covering 1125 pages of text. There are 542 engravings, including 7 full-page colored plates. The work is in reality a textbook. The author says that in the compilation of the work the needs of the student have been constantly in mind. Physicians engaged in practice find it difficult properly to diagnose and treat diseases involving the alimentary tract, without recourse to a thoroughly modern, practical reference book on this special subject. With this in mind the author has attempted, and successfully, to supplement their present knowledge of gastroenterology in his volumes.

**INTESTINAL TOXEMIA, Biologically Considered.** By Anthony Bassler, M.D. Phila., F. A. Davis Co., 1930.

Reading the author's long Preface we came to: ". . . because I had decreed that the final report of the work had to cover a large number of cases in which constant research and laboratory detail had to be engaged in—work, which at best is far from easy and plain—I concluded not to write this experience in more detail until five thousand cases had been treated. This has taken thirty years of time, constant researching, examinations, checking and rechecking, and the estimation of results immediately accomplished, but, more particularly, results apparent years after termination of treatment." This gives an idea of the thoroughness with which the author has handled his subject.

Whether or not you agree with all the author says, what he writes will command serious attention. Naturally most gastroenterologists will read it, but we would that many men labelled "general practitioners" would spend some time each day and learn the basic fundamentals to be found between its covers. The book deserves a wide circulation.

**DIE WIRBELBRÜCHE UND IHRE ERGEBNISSE.** By Dr. Walter Haumann, Stuttgart, Ferdinand Enke, 1930. Pp. 180, 20 illus.

The monograph here under review details the experience of the author in 204 fractures of the spine treated over a five year period from 1919 to 1925, in a hospital in the Ruhr coal mining district, together with 555 cases occurring during 1919 to 1920 in the insurance district of that region. As a statistical summary of so extensive a material the book is of great value.

The first section of the book takes up the pathology both from the clinical side and as seen at autopsy. The importance of the x-ray is stressed, and particularly the fact that in many cases only in the lateral x-ray exposure may the fracture be demonstrated, a fact that is still frequently overlooked in surgical practice.

The treatment as developed by Haumann, which was used in substantially all of the hospital series of 204 cases, is recumbency in bed, sometimes with a pillow under the fracture site, for six weeks. Energetic physiotherapeutic measures are employed almost from the first, including at first heat and massage, and later active mobilization exercises. At the end of that time the patient is gotten up without support, the average hospital stay being about nine weeks. Laminectomy is never done. Only twice was a fixation operation done. No attempt is made to reduce deformity.

Much of this, of course, would be considered rather inadequate treatment in America, where the practice in general has been to make some systematic attempt to restore the anatomical conformation, as in any other joint fracture, and then to protect the crushed vertebral body from overstrain until consolidation is complete. Fixation operations are here utilized to a far greater degree.

X-rays of 20 cases are reproduced in the text, illustrative of different types of injury. It is to the reviewer a matter of regret that substantially no x-rays of what might be called end-results are reproduced, despite the opportunity which was here offered for late observations. One other point which your reviewer, as an orthopedic surgeon, cannot refrain from comment upon is this: here and there in the book it is advanced as a criterion of spinal function that the patient can place his finger tips so and so many centimeters from the floor. A statement with regard to the degree of spinal

mobility would have been much more to the point, since, as is well known to every one, by far the greatest portion of trunk flexion is carried out at the hip joints.

The end-result study is based rather largely on percentage disability as determined from the insurance standpoint. It at once becomes evident to the American reader that the standards which maintained in the Ruhr during the post-war reconstruction years bear little relation to those of our compensation laws. A single case may be quoted to illustrate (p. 64). A fracture of the first lumbar vertebral body with initial symptoms of a complete cord lesion, but subsequently developing a marked spastic paraplegia. He was eventually able to get about with the aid of crutches. At the end of two years he was given a percentage disability rating of 40 per cent. Such a case, in American insurance practice, would be rated as substantially a 100 per cent disability. One is tempted somewhat to interpret the physical integrity of those cases in the series who eventually were able to return to their previous occupations by considerations such as the above.

Despite one's differences with the author's point of view, it should be stated that the book should prove of considerable value to all those interested in this very difficult question of the management of fractures of the spine.

ARTHUR KRIDA.

**PRACTICAL MIDWIFERY FOR NURSES.** By Bethel Solomons, M.D. Oxford Univ. Press, 1930.

In the Preface the Author writes: "The long-standing success of Practical Obstetrics by Tweedy and Wrench has continued since the publication of the last edition in 1929, when I took charge of this well-known textbook. Having been asked by many nurses to produce a smaller work on the same lines, I decided to accede to their wishes. While the requirements of modern obstetrics, and especially my own views, will be found in the book, some of the original ideas of Tweedy and Wrench still remain, and to these two authors my acknowledgments are especially due. An effort has been made to bring before the nurse not only hospital work, but also the subject as it applies to private practice."

This book is carefully done. The subject is thoroughly covered. Any nurse might well spend a few hours reading between its covers.

We recommend it be added to the lists prepared by the supervising nurse of training schools throughout the country for the reading and the study of nurses in training.

**HIERONYMI FRACASTORII. DE CONTAGIONE ET CONTAGIOSIS MORBIS ET EORUM CURATIONE, Libri III.** Transl. and Notes by Wilmer Cave Wright, PH.D. Pp. 411.

**HISTORY OF MEDICINE SERIES** Issued under the Auspices of the Library of the New York Academy of Medicine. No. II. 2 illus. N. Y., G. P. Putnam's Sons, 1930.

With the original Latin text on the left hand page and the first English translation on the right, this book is a valuable contribution to the History of Medicine. It makes easily available for the first time the original Latin text and the complete English translation of Fracastorius' "De Contagione." Fracastorius' ideas on infection were at variance with those of his contemporaries.

The book is the second volume of a History of Medicine series to be published under the auspices of the New York Academy of Medicine. Volume I, which has not yet appeared, will be "The First Books on Medicine and the Sciences, a Bibliography of Incunabula," compiled by Arnold C. Klebs.

**OPERATIVE GYNECOLOGY.** By Harry Sturges Crossen, M.D., F.A.C.S., and Robert James Crossen, M.D. Ed. 4, St. Louis, C. V. Mosby Co., 1930.

Crossen's Operative Gynecology has from its first publication been accepted by gynecologists and surgeons as a work of the highest excellence. The fact that it is now offered in its fourth edition attests these facts.

It is a well-made book of slightly over a thousand pages. It has 1246 illustrations and 2 color plates. The illustrations have been well reproduced and amplify the text. The undergraduate and hospital interne may well spend many hours slowly going through this volume. The young assistant should make it a part of his daily reading and study. The master of gynecology will review it with profit and pleasure. It is sure to offer many hints that will improve his daily routine work.

Crossen's Operative Gynecology should be in a majority of medical libraries.

**TELERADIOGRAPHIE-STEREORADIOGRAPHIE, Applications Medico-Chirurgicales.** By L.

Diocles. Paper, 335 p., 40 illus., Paris, Masson et Cie, 1930.

The author of this book has devoted his interest particularly to the application of stereoscopy in radiography. He has followed the work of various authors, both in France and in foreign countries, and in the historical section of the book gives adequate credit to all who have contributed to the perfection of stereoradiodiagnosis. There is an excellent discussion on binocular vision, stereoradiography and teleradiography. The author describes some ingenious improvements in apparatus, which are the result of his investigations. He highly recommends the small hand prism stereoscope for studying the films, and concludes with chapters on the application of stereoradiography to the various fields of medicine. Some beautiful examples of stereograms are included in the text.

JAMES T. CASE.

LEHRBUCH DER CHIRURGIE. By A. von Eiselsberg, Gewidmet von Seinen Schülern. Herausgegeben von P. Clairmont, H. V. Haberer, W. Denk, E. Ranzi. Redigiert von W. Denk. Vol. I, pp. 884, 389 illus. Vol. II, pp. 672, 298 illus. Berl., Julius Springer, 1930.

We have before us two volumes of a new "Lehrbuch der Chirurgie" dedicated to Prof. A. von Eiselsberg by his students. It is presumed that these two volumes form the complete work, though there is nothing to indicate this. The absence of a preface is rather surprising.

Edited by Drs. P. Clairmont, H. v. Haberer, W. Denk and E. Ranzi and with contributions by the following men: Adolf Winkelbauer, Max Sgalitzer, Egon Ranzi-Innsbruck and Fritz Starlinger, Otto Marburg and Egon Ranzi-Innsbruck, Waldemar Goldschmidt, Hans Piehler, Burghard Breitner, Gustav Hofer, Heinrich Neumann, Paul Clairmont, Wolfgang Denk, Hans v. Haberer. Leopold Schönbauer, Peter Walzel, Theodor Hryntschak and Hans Rubritius, Otto Frisch, and Rudolf Demel, the work may be looked upon as a standard representation of German surgery of today.

There are almost 700 illustrations, many of them original and all of them good.

OUTLINE IN OBSTETRICS FOR NURSES. By F. W. Rice, M.D. St. Louis, C. V. Mosby Co., 1930.

This outline represents the accumulation of notes used by the author in lecturing to nurses. It is a quick reference book, enabling both the graduate and the student nurse to get a bird's-eye view of the symptoms and treatment of a condition without stopping to read a whole chapter in a textbook. This is a very practical little book. Designed for student nurses it will, no doubt, be widely used in classrooms. Some nurses some time graduated might well spend a few hours and relearn many facts to be found in its pages.

## BOOKS RECEIVED

All books received by THE AMERICAN JOURNAL OF SURGERY are listed in this column as soon as possible after their receipt and this must be considered as adequate acknowledgment. Books that the Editor considers of special interest to our readers will be reviewed in a later issue.

ACROCYANOSIS (LES). By Fernand Laynal. Paris, Masson, 1929.

ANAESTHESIA AND ANAESTHETICS. By F. S. Rood and H. N. Webber. N. Y., Wood, 1930.

APPROACHING MOTHERHOOD. By George L. Brodhead, M.D. Ed. 3, N. Y., Hoeber, 1929.

ARBEITEN AUS DEM NEUROLOGISCHEN INSTITUTE. By Heinrich Obersteiner and Otto Marburg. Wien, Deuticke, 1930.

ARTHRITE CHRONIQUE DE LA HANCHE (L'). By L. Duvernay. Paris, Masson, 1930.

ARTIFICIAL SUNLIGHT. By M. Luckiesh, D.Sc. N. Y., Van Nostrand, 1930.

AUTONOMIA DEL CORAZON (LA). By Prof. Dr. Alejandro Lipschutz. Univ. de Concepcion, 1929.

AVERTINNARKOSE IN DER CHIRURGIE (DIE). By W. Anschutz, K. Specht and F. Tiemann. Berlin, Springer, 1930.

CANDIRU. By Eugene Willis Gudger, Ph.D. N. Y., Hoeber, 1930.

CHEST IN CHILDREN. By E. Gordon Stolloff, M.D. Annals of Roentgenology XII. N. Y., Hoeber, 1930.

CLINICAL METHODS. By Robert Hutchison, M.D., F.R.C.P., and Donald Hunter, M.D., F.R.C.P. Ed. 9 N. Y., Hoeber, 1929.

CLINIQUE ET THERAPEUTIQUE CHIRURGICALES. By George Pascalis. Paris, Doin, 1930.

CHIRURGISCHE DIATHERMIE (DIE). By H. Henseler, M.D. Berlin, Radionta, 1929.

DIAGNOSTIC ET THERAPEUTIQUE ELECTRO-RADIOLOGIQUE. By A. Zimmern and J. A. Chavany. Paris, Masson, 1930.

DIAGNOSTICS URGENTS—ABDOMEN. By H. Mondor. Paris, Masson, 1930.

DOSAGE TABLES FOR ROENTGEN THERAPY. By Prof. Friedrich Voltz. Oxford, 1930.

FONCTIONS HEPATO-BILIAIRES (LES). By M. Chirary and F. Thiebault. Paris, Masson, 1930.



- FRANKFURTER ZEITSCHRIFT FÜR PATHOLOGIE. By Prof. Dr. B. Fischer-Wasels. München, Bergmann, 1930.
- FUNDAMENTAL PRINCIPLES OF ALVEOLO-DENTAL RADIOLOGY. By Joseph Andrea Pollia, M.D. Brooklyn, Dental Items of Int. Publ., 1930.
- GRAY'S ANATOMY. By Warren H. Lewis, M.S., M.C. Ed. 22, Phila., Lea & Febiger, 1930.
- GRUNDZÜGE DER NEUROCHIRURGIE. By Walter Lehmann. Dresden, Steinkopff, 1930.
- HANDBOOK OF THE VACCINE TREATMENT OF CHRONIC RHEUMATIC DISEASE. By H. Warren Crowe, M.D., B.Ch., M.R.C.S., L.R.C.P. Oxford, 1930.
- HISTORY OF HAITIAN MEDICINE. By Robert P. Parsons, Lieut.-Com. M.C., U.S.N. N. Y., Hoeber, 1930.
- INDEX OF DIFFERENTIAL DIAGNOSIS OF MAIN SYMPTOMS (AN). By Herbert French, C.B.E., M.A., M.D., F.R.C.P. Ed. 4, N. Y., Wood, 1928.
- INTRODUCTION TO DIATHERMY. By H. Henseler, M.D. Trans. by E. Fritsche. Berlin, Radionta, 1929.
- KNOCHENBRUCHBEHANDLUNG MIT DRAHTZUGEN (Die). By Prof. Rudolf Klapp and Werner Block. Berlin, Urban & Schwarzenberg, 1930.
- KYKLOS. Vol. 3, Leipzig, Thieme, 1930.
- LEGAL MEDICINE AND TOXICOLOGY. By Ralph W. Webster, M.D., Ph.D. Phila., Saunders, 1930.
- LEHRBUCH DER MUND-UND KIEFERSCHIRURGIE. By Erich Sonntag, M.D. and Wolfgang Rosenthal, M.D. Leipzig, Thieme, 1930.
- MANUEL ELEMENTAIRE DE PSYCHIATRIE. By M. Nathan. Paris, Masson, 1930.
- MEDICAL ART CALENDAR—1931. Amsterdam, Kruseman, 1930.
- MEDICAL JURISPRUDENCE. By Elmer D. Brothers, B.S., LL.D. Ed. 3, St. Louis, Mosby, 1930.
- MEDICAL AND SURGICAL YEAR BOOK. By the Physicians Hospital of Plattsburgh. Plattsburgh, N. Y., Minor Found., 1930.
- MUND-UND HALSOPERATIONEN (Die). By J. Soerensen. Berlin, Urban & Schwarzenberg, 1930.
- NEUROANATOMY. By J. H. Globus, M.D. Ed. 4, N. Y., Hoeber, 1929.
- NORMAL DIET. By W. D. Sansum, M.S., M.D., F.A.C.P. Ed. 3, St. Louis, Mosby, 1930.
- OPERIERTE MAGEN (Der). By Hermann Meyer Burgdorff. Leipzig, Thieme, 1930.
- OSTEO-SYNTHESE METALLIQUE (L'). By Robert Frantz, Paris, Masson, 1929.
- OTOLOGIC SURGERY. By Samuel J. Kopetzky, M.D., F.A.C.S. Ed. 2, N. Y., Hoeber, 1929.
- OTOSCLEROSIS. A Resume of the Literature to July, 1928. Compiled under Direction of Committee on Otosclerosis, American Otological Soc. N. Y., Hoeber, 1929.
- PEPTIC ULCER, Roentgenologically Considered. By Jacob Buckstein, M.D. Annals of Roentgenology XI. N. Y., Hoeber, 1930.
- PERMEABILITE ET LES OBTURATIONS TUBAIRES (La). By Claude Beclare. Paris, Masson, 1929.
- PHYSIOLOGIE PATHOLOGIQUE CHIRURGICALE. By R. Leriche and A. Policard. Paris, Masson, 1930.
- PLEXUS CHOROIDEI (LES). By Nathalie Zand, M.D. Paris, Masson, 1930.
- PRATIQUE CHIRURGICALE ILLUSTRÉE (La). By Victor Pauchet. Paris, Doin, 1930.
- PRIMER ON FRACTURES. Prepared by Cooperative Committee on Fractures. Chicago, A. M. A., 1930.
- PSYCHIATRIE. By Andre Barbe. Paris, Masson, 1930.
- RACHIANESTHESIE (La). By Emile Forgue and Antoine Basset. Paris, Masson, 1930.
- ROENTGENBEHANDLUNG DER NERVENKRANKHEITEN (Die). By Otto Marburg and Max Sgalitzer. Berlin, Urban & Schwarzenberg, 1930.
- ROENTGEN-LITERATUR (Die). By Herman Gocht. Stuttgart, Enke, 1930.
- SACRO-CONALGIE ET SON TRAITEMENT (La). By Pierre Ingelrans. Paris, Masson, 1930.
- SELECTED READINGS IN THE HISTORY OF PHYSIOLOGY. By John F. Fulton. Springfield, Thomas, 1930.
- STALKERS OF PESTILENCE. By Wade W. Oliver, M.D. N. Y., Hoeber, 1930.
- STANDARDS FOR MATERNITY CARE. N. Y., Children's Welfare Federation N. Y. C., 1930.
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A CLINICAL STUDY OF THE  
ABDOMINAL CAVITY AND PERITONEUM

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# A CLINICAL STUDY OF THE ABDOMINAL CAVITY AND PERITONEUM\*

## SECTION II. THE GASTROINTESTINAL TRACT (*Continued*)

### D. THE ABDOMINAL LYMPHATIC SYSTEM (*Continued*)

Enlarged intra-abdominal lymph nodes are often unexpectedly encountered during the course of abdominal operations. Their discovery calls for answers to the following questions:

1. What group of glands is enlarged; is more than one group involved; is the lymphadenopathy generalized; if a single node is implicated, to what group does this node belong?†

2. What afferent lymph vessels lead to the enlarged gland, or glands (i.e., where is the probable seat of the pathological process which caused the involvement of the nodes)?

3. What are the minute local characteristics of the lymph glands (large or small; hard or soft; movable or attached; discrete or matted)?

4. Was there anything among the preoperative data to suggest the presence of a lymphadenopathy or to offer a likely explanation as to its significance (abnormalities of superficial nodes; large spleen; history, for example, of tuberculosis; laboratory findings, such as those of leucemia; evidences of some acute infectious process)?

5. Is it advisable to remove a gland for laboratory study (biopsy)?

Sometimes a local lesion is at once seen which almost certainly accounts for the lymph node involvement (infected

\* Previous installments of this book appeared as follows: Vol. viii: January issue, p. 193; February issue, p. 459; March issue, p. 693; April issue, p. 911; May issue, p. 1109; June issue, p. 1325; Vol. ix: July issue, p. 157; August issue, p. 365; September issue, p. 581; Vol. x: October issue, p. 419; November issue, p. 473.

† The terms lymph node and lymph gland will here be used interchangeably.

gall bladder; cancer of stomach). But there are other times when a primary lesion is to be found only during the course of a systematic search to ascertain the cause of the local lymphadenopathy. Knowledge of regional glandular relationships is as essential to a successful intra-abdominal exploration as to a competent preoperative physical examination. Enlarged lymph nodes within the belly should be accorded as detailed study as is routinely given enlarged cervical nodes. And it is of importance that among operative findings the characteristics of the nodes be recorded.

The location of intra-abdominal nodes is (1) about the walls of viscera, (2) along arterial trunks supplying the viscera, and (3) about the great prevertebral abdominal vessels (aorta and inferior vena cava). The major lymph node groups are the mesenteric nodes, the lumbar nodes, and the celiac nodes.

Each lymph gland, it is to be recalled, is supplied by the lymph vessels which drain a specific area (its afferent vessels); and from each node, in turn, pass off lymph vessels which go to more central parts of the lymphatic system (its efferent vessels).

Nodes associated with individual abdominal viscera are here illustrated rather than described. But in discussions concerning the practical significance of these nodes (see acute inflammations; cancer) certain of the viscera with their intimate sets of lymph glands (visceral nodes) are dealt with at considerable length.

Nodes of the mesenteric group number roughly from 100 to 150.<sup>282</sup> They lie between the peritoneal layers of the mesentery along the rami intestinales and vascular arcades of the superior mesenteric artery (Fig. 191 A, B). They receive their afferent vessels from jejunum, ileum, appendix, cecum, ascending and transverse colons. Efferent lymph vessels from the more proximally situated nodes unite to form a common intestinal trunk (truncus intestinalis) which enters the cisterna chyli.

## Lumbar Nodes

The lumbar nodes lie behind the peritoneum of the posterior abdominal wall, upon the psoas and quadratus lumborum muscles and in close association with the abdominal aorta

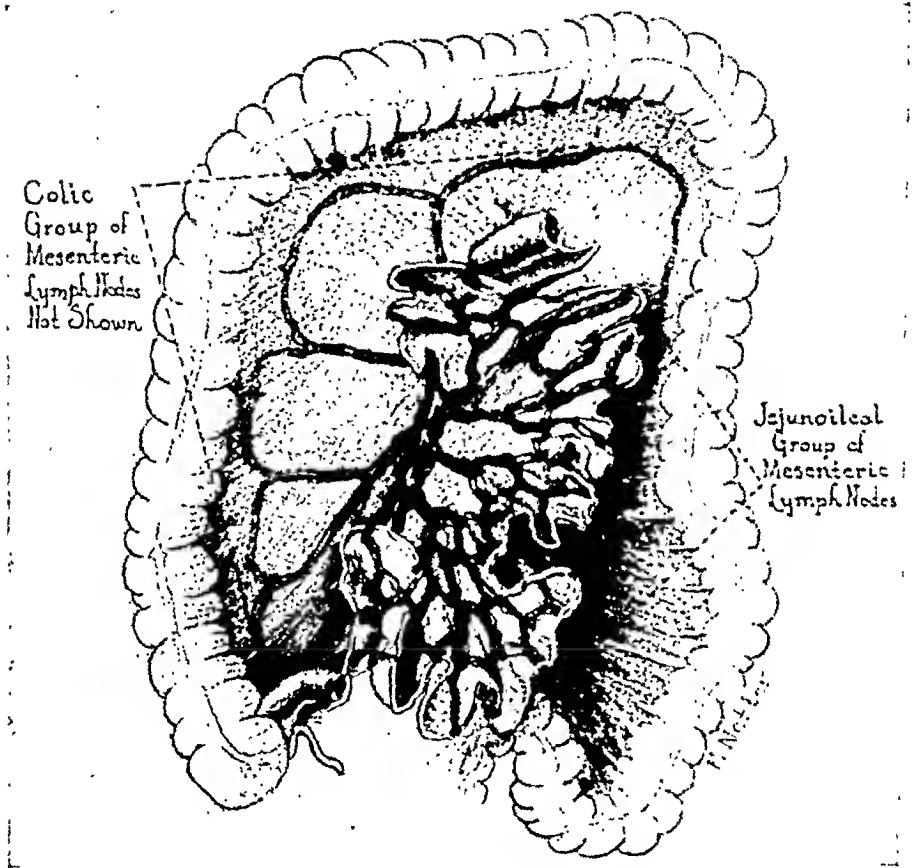


FIG. 191. The mesenteric lymph nodes.

A. Jejunioileal nodes. Note the distribution of the lymph glands along the vascular arcades of branches of the superior mesenteric artery. Observe that the course of the artery determines the direction or obliquity of the root of the mesentery. Small bowel has been cut away to show the fan-like arrangement of the mesentery and the distribution of the nodes.

and the inferior vena cava (Fig. 192). They receive afferent vessels from the lower extremities (femoral, inguinal, pubic, external iliac nodes), from the pelvis (sacral, hypogastric, common iliac nodes), from genital and urinary organs, from the posterior abdominal wall, and from part of the large

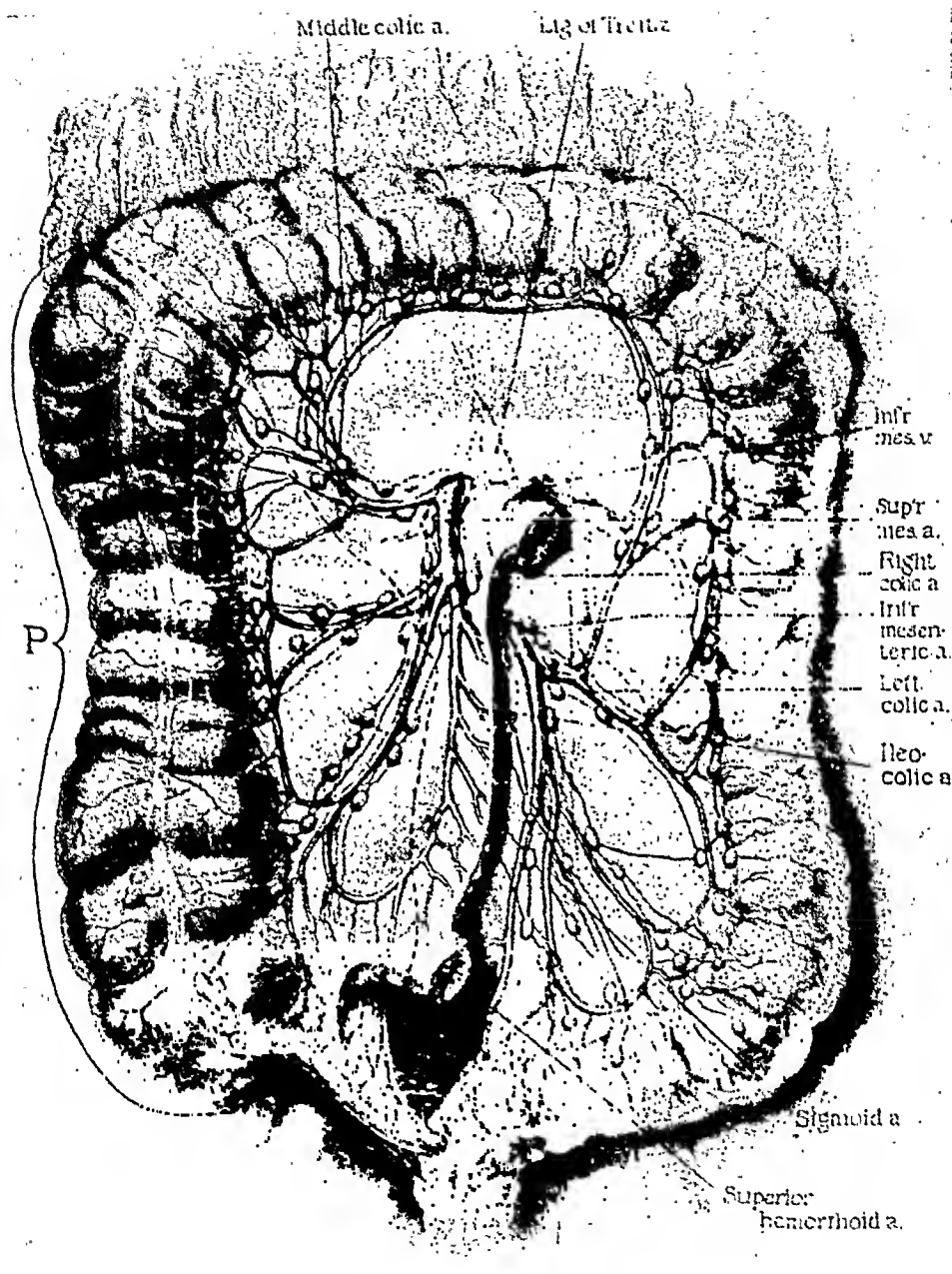


FIG. 191.

b. Colic nodes. Note distribution of lymph nodes along the inferior mesenteric, ileocolic, right, left, and middle colic arteries. The jejunoileal mesentery has been severed near its base to expose the colic vessels and nodes. (From Printy.)

intestine. The lumbar glands drain into the cisterna chyli by way of two lymph trunks, the right and left trunci lumbales.

The celiac nodes are those in connection with the celiac

#### Celiac Nodes

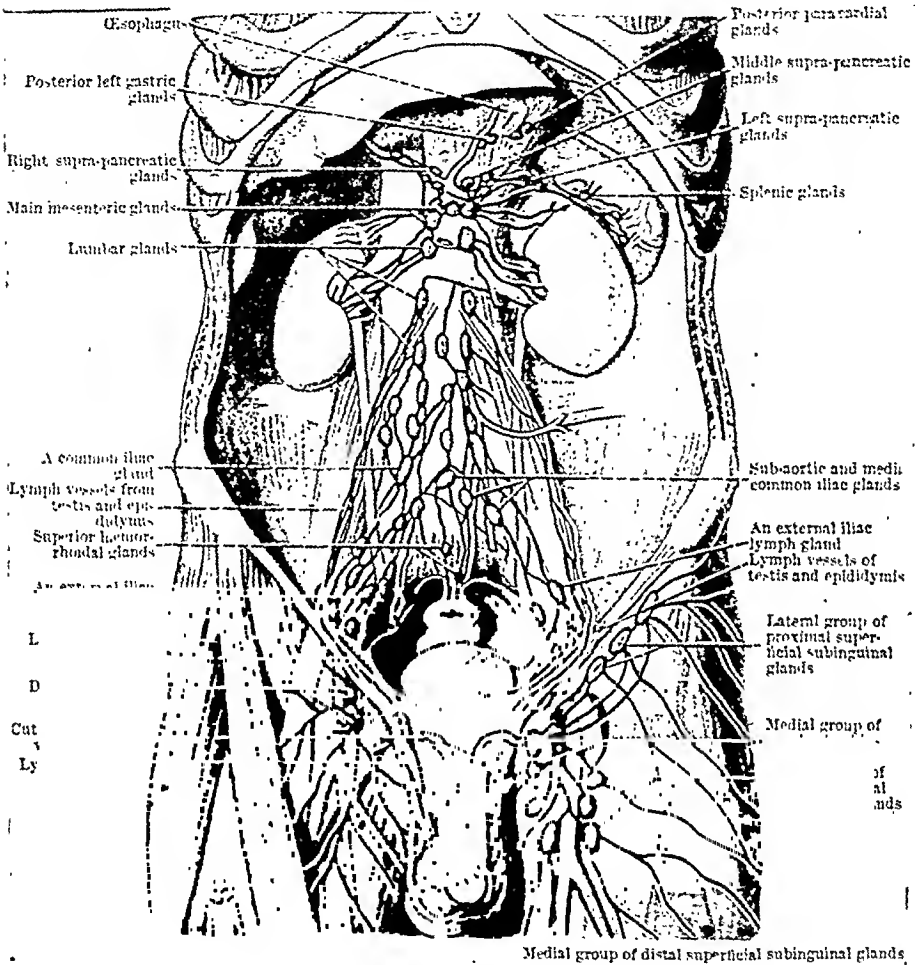


FIG. 192. Retroperitoneal lymph nodes.

Lumbar and celiac groups of nodes showing distribution along great prevertebral vascular trunks and, in part, the drainage areas for these lymph glands. (From Cunningham.)

axis; they are few in number (15 to 20), large in size,<sup>282</sup> and receive the lymphatic drainage from a large part of the liver, spleen, pancreas, and stomach (*see* Fig. 192). The celiac glands through their efferent vessels drain into the cisterna

chyli, for the most part by way of the main intestinal lymph trunk, in common with the collected efferents from the superior mesenteric lymph glands.

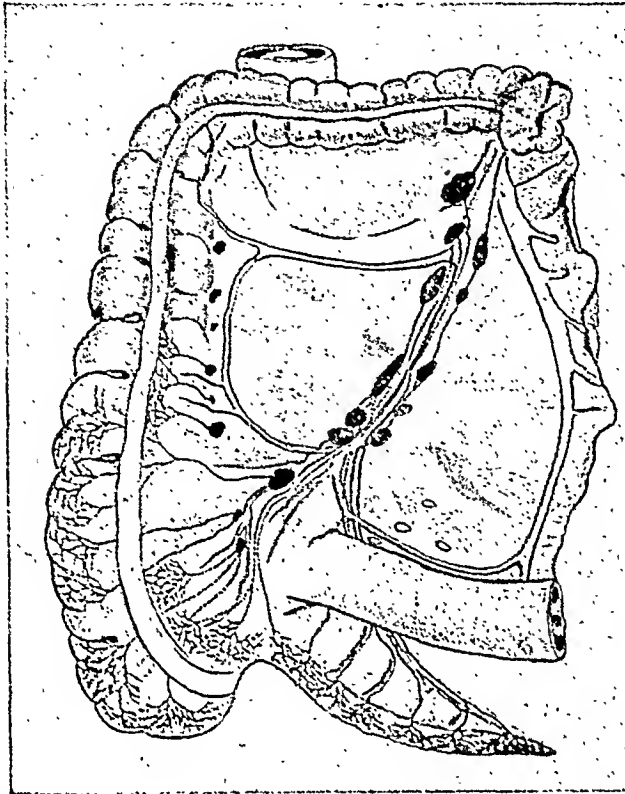


FIG. 193. Lymph vessels and lymph nodes draining ileocecal region. Note paracolic nodes, inferior, intermediate, and superior groups along ileocolic artery, with drainage toward nodes at the origin of the superior mesenteric artery from the abdominal aorta. (From Jamieson and Dobson.)

Collectively the lumbar group and celiac group constitute the so-called retroperitoneal lymph glands thus distinguishing these from mesenteric nodes.<sup>283</sup> Strictly speaking every intraabdominal lymph node is retroperitoneal in location for even the mesenteric nodes, situated between the leaves of the jejunoileal mesentery, are anatomically retroperitoneal.

It is possible quite accurately to describe the lymphatic nodes and drainage pathways from any specific abdominal organ by first naming the small visceral groups of nodes which lie in intimate contact with various parts of the organ (see

illustrations), then the nodes along the main arteries which lead to the organ in question, and lastly the major glandular group found in closest proximity to the proximal extremity

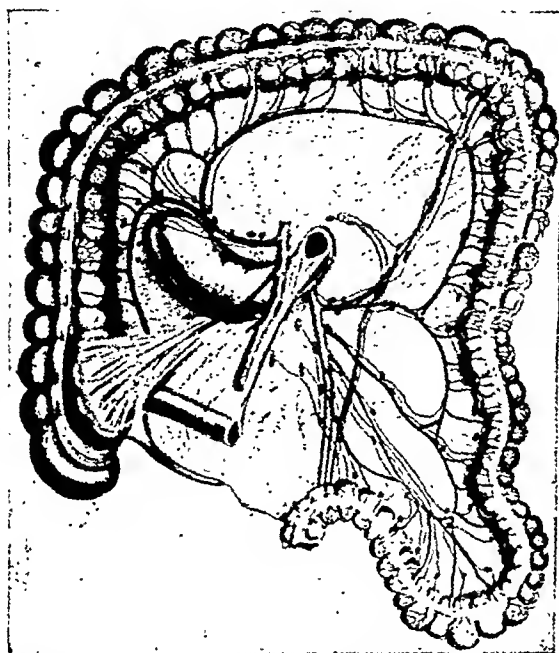


FIG. 194. Lymph vessels and lymph nodes draining pelvic colon. Observe paracolic groups, inferior, intermediate, and superior groups along the inferior mesenteric and left colic arteries. (From Jamieson and Dobson.)

of the main artery to the organ. The walls of the cecum, for example, contain afferent lymph vessels which pass into nodes lying immediately upon or along the cecal walls (anterior and posterior cecal nodes); from these nodes efferent vessels pass to the nodes along the ileocolic artery; and from these, in turn, other lymph vessels pass to more proximal nodes along the superior mesenteric artery; and the lymph flow ultimately reaches the cisterna chyli by way of the truncus intestinalis (Fig. 193). Again, the normal lymph current from within the pelvic colon passes by way of epicolic and pericolic nodes, situated near the mesocolic border of the pelvic colon, to nodes (intermediate and proximal groups)

found along the course of the inferior mesenteric artery; and thence to the cisterna chyli by way of either the right or left lumbar lymphatic trunks (Fig. 194).

Intra-abdominal lymphadenopathies, as those elsewhere in the body, are most often due to:<sup>284</sup> acute inflammations, tuberculosis, syphilis, secondary malignancies, Hodgkin's disease, leueemia or lymphosareoma. Of chief surgical interest are (a) inflammatory lymphadenopathies, (b) malignant lymphadenopathies, and (c) tuberculous lymphadenopathies. Intra-abdominal lymphatic enlargements due to syphilis are of relatively slight importance and treatment is medical. And if the primary or essential lymphadenomata are of surgical interest this is largely from the standpoint of differential diagnosis, since, for conditions grouped under this heading, cures by means of operations are scarcely to be anticipated.

Acute intra-abdominal inflammations, as acute inflammations elsewhere, cause associated and secondary lymphadenopathies. The nodes which must bear the brunt of the septic absorption are usually those in closest proximity to the local focus of infection. An outpost for the gall bladder is found along the cystic artery (hence along the cystic duct); and within the angle formed by the union of cystic and common ducts lies a "sentinel gland" (the cystic node). This node when enlarged is not infrequently mistaken for a calculus.<sup>285</sup> And care is needed, during palpation, to determine whether a small, firm, rounded or ovoid body in this region is in reality situated within or without the cystic duct. In addition to the cystic gland more remote biliary drainage glands are found along the bile ducts and hepatic artery. The normal lymphatic current is directed toward the celiac glands and the most proximal node within the biliary chain is located posterior to the head of the pancreas, close to the lower end of the common bile duct. Much work has been done to ascertain the rôle of the lymphatics in determining the relationship so often observed between cholecystitis and pancreatitis.<sup>286</sup> Another sentinel gland is sometimes found



within the mesoappendix. More remote nodes for the appendix are the distal, intermediate, and proximal ileocolic nodes. Still another sentinal gland is the so-called gastric node (sentinel gland of Lund (Fig. 195)).<sup>27</sup> This receives its afferent vessels from the proximal duodenum and pylorus. Situated in association with the right gastric artery immediately above the pylorus within the lesser omentum or hepatogastric ligament, this node is of considerable importance with reference to peptic ulcers, particularly when the ulcers are small, obscure, and easily overlooked. Similarly, just as the supraclavicular node of Troisier because of its relation to pathways of lymphatic drainage has peculiar significance in abdominal affections (particularly malignancies), and as the node of Quenu situated near the ischial tuberosity<sup>28</sup> bears a relationship to perirectal and other deep pelvic affections, so the cystic gland, the appendicular gland, the right gastric gland, and other individual lymphatic nodes, serve as sentinels of diagnostic value and importance to observant clinicians.

In addition to their diagnostic significance inflamed intra-abdominal nodes may account for operative failures (secondary abscess formation; chronic complaints) and for widespread extensions from originally well localized foci (generalized peritonitis due to a ruptured lymph node). Confronted, during operation, by a supposedly acutely inflamed lymph node, the surgeon must ask himself some of the previously suggested questions (p. 524), in an effort to determine with all possible accuracy whether the tentative diagnosis is consistent with the lymphatic enlargement present. When the number, size, shape, consistency, or arrangement of the involved nodes is not consistent with the presumptive diagnosis of some single inflammatory focus, or when the character of the nodes in any way excites suspicion, some attempt should be made, from a more extended review of the lymphatic system, to reach an alternative diagnosis.

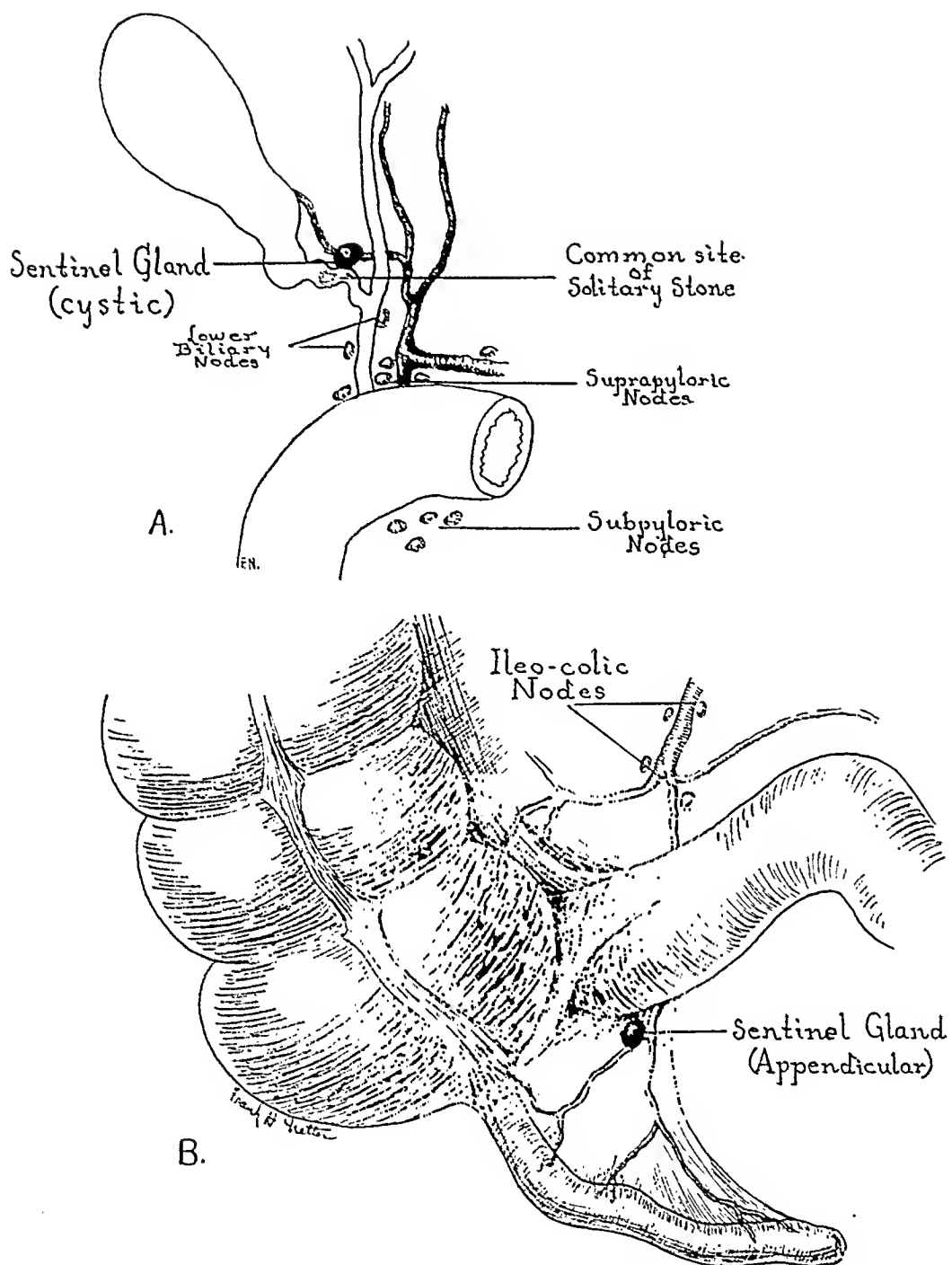


FIG. 195. Sentinel lymph nodes.

- A. The cystic node.
- B. The appendicular node.

Secondary malignant lymphadenopathies are caused by lymph permeation or lymphatic embolus formation. By lymph permeation is meant the development along lymph channels of a continuous chain of malignant cells leading from the primary tumor to the involved node. This process has been shown to account for extension of cancer into the abdominal cavity from without,<sup>289</sup> for example, involvement of nodes along the falciform ligament of the liver from a primary tumor of the breast. It also explains certain cases of malignant spread from intra-abdominal organs to the body surface, such for example, as the invasion of supraclavicular nodes from a primary tumor of the ovary (Fig. 196). The results of microscopical studies concerning the phenomenon of lymph permeation are visually depicted in accompanying illustrations which show to what remote regions tumor cell-chains may extend.

There seems clear-cut evidence that clusters of malignant cells also move along lymph channels in the form of emboli,<sup>290</sup> lodging as a rule in the first lymph node filters to be encountered (Fig. 197). Malignant emboli may reach the cisterna chyli and thoracic duct, to pass at the base of the neck into the venous circulation. Certain clinically observed malignant metastases would prove difficult to explain except upon the basis of such a secondary invasion of the blood stream.

Because of the serious import of a secondary deposit of malignant cells along a lymph channel or within a lymph node it proves necessary, in order to effect a surgical cure, that every vestige of malignant tissue be excised. Hence, operations for the removal of malignant growths in reality represent studies in the surgical anatomy of the lymphatic system.<sup>291</sup> This presupposes that surgeons possess precise knowledge as to all usual and likely pathways for extension. By means of post-mortem studies this incidence of invasion of every group or subgroup of nodes has been worked out for each common intra-abdominal malignancy. Danger points have been accurately determined. The extent of necessary



FIG. 196. Lymph permeation.

Method of malignant extension along lymphatic vessels by solid cellular chains.

Primary malignancy of right breast (note retraction, elevation, and deformity of breast) with extensions through lymph permeation: A, to axilla; B, to intercostal nodes; C, to mediastinal nodes; D, to supraclavicular nodes; E, to head of humerus; F, G, to opposite side of thorax; H, to epigastric nodes; I, to umbilical nodes, and J, along falciform ligament to liver; K, to inguinal nodes and to neck of femur.

The abdomen is invaded through routes H, I, and J.

excisions is known. Two factors indicate that it is necessary to make excisions more extensive than might at first seem required. The first factor is this: not all the afferent lymph channels from a primary site lead to the node or nodes nearest the growth. Some pass without interruption to more distant lymph glands. Thus an early lymph node metastasis from an ileocecal carcinoma may be situated, not in close proximity to the primary tumor, but near the point at which the ileocolic artery springs from the superior mesenteric artery; a node in this location may show undoubted microscopic evidences of involvement while the intermediate, and the distal ileocolic nodes remain free from tumor cells. The second factor which indicates the necessity for wide excisions is that normal lymphatic pathways often become obstructed by tumor cells, causing a reversal of the lymph current with a flow to collateral routes. This results in the formation of metastatic tumors in unexpected regions (aberrant implantations) Malignant plugging or obstruction of the normal lymphatic route from cecum to nodes along the ileocolic artery not infrequently causes metastases to appear within juxtaintestinal nodes of terminal ileum and ascending colon. And although the primary tumor never extends any great distance along the alimentary canal it is necessary, when dealing with an ileocecal carcinoma, to remove several inches to terminal ileum and a large part of the ascending colon. The limits of necessary intestinal excisions are determined in part by the presence of involved lymph nodes along the bowel walls and in part by the distribution of arteries which must be ligated. The points of arterial ligations, in turn, are predetermined by the presence along major vessels of common sites for glandular metastases. (Fig. 198.)

Operations for the removal of gastrointestinal malignancies have been mapped out upon the basis of proved routes of lymphatic spread as determined by the study of necropsy material and of tissues excised during operations. The removal of lymphatic structures en bloc necessitates at times the liga-

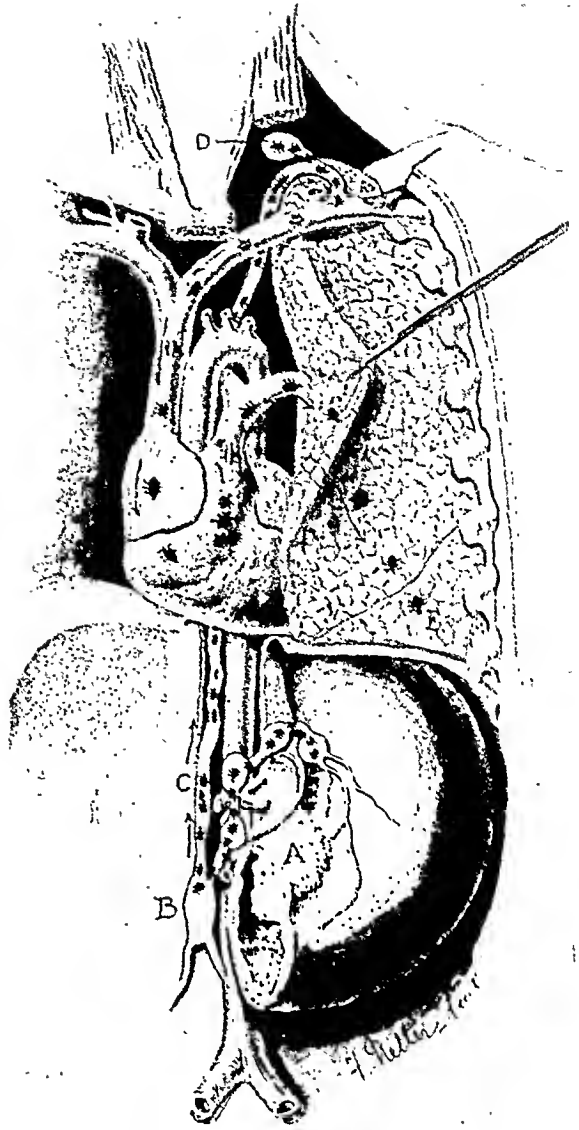


FIG. 197. Malignant emboli.

Clusters of malignant cells originating at primary tumor of stomach (A) travel along afferent lymph vessels to anterior left gastric nodes, to posterior left gastric, coronary, celiac, and superior mesenteric nodes. By way of the truncus intestinalis they enter the cisterna chyli (B), travel upward along the thoracic duct (C), and enter the systemic venous circulation at the left side of the base of the neck; traversing the innominate vein they enter the right auricle of the heart; passing through the right ventricle and pulmonary artery the cells are desposited in the tissues of the lung where secondary or metastatic nodes grow. At D is seen a Troisier or Virehow-Troisier gland (situated behind sternal head of left sternomastoid muscle) an important sentinel node for intra-abdominal malignancies. Clinically the nodes near the stomach are practically always involved, the cervical nodes are rarely involved while involvement of pulmonary tissues from a gastric neoplasm is a great rarity.

tion of important arteries because of the proximity to these vascular trunks of lymph nodes which it might prove dangerous to leave behind; and this makes necessary the excision also of such segments of the intestinal tract as are thus to be deprived of their arterial blood supply. Accompanying figures illustrate some of the operations proposed by various authorities (Figs. 198 and 199). The statement appears quite true that surgery for gastrointestinal malignancies is the surgery of the gastrointestinal lymphatic system.

Cancer of the stomach is the most common malignant disease affecting the male. To review salient facts concerning the operative management of this condition further focuses attention upon the anatomy of abdominal lymphatics and serves to give additional emphasis to general principles involved in the surgical treatment of malignant neoplasms.

Gastric lymph nodes, according to a previously stated rule, follow roughly the distribution of gastric arteries. But the gastric arteries spring from trunks which supply as well as the stomach other important viscera of the supracolic division of the peritoneal cavity. Blood to the right extremity of the stomach comes from branches of the hepatic artery; and blood to the left half of the greater curvature comes from branches of the splenic artery. Similarly many of the gastric lymph nodes serve as drainage filters for other viscera as well as for the stomach. This intimate association of the lymphatic drainage basins from upper abdominal organs seems, upon first consideration, to render the study of gastric lymphatics complex. The complexity, however, is largely one of nomenclature and is more apparent than real. The situation is clarified by first studying gastric nodes solely in their relation to gastric circulation without reference to confusing names which tend to obscure this association of nodes and arteries.

The immediate or primary lymph drainage of the stomach is to nodes situated directly upon or in close juxtaposition to gastric walls; the more remote or secondary lymph drainage is to nodes located along the vascular trunks of the celiac

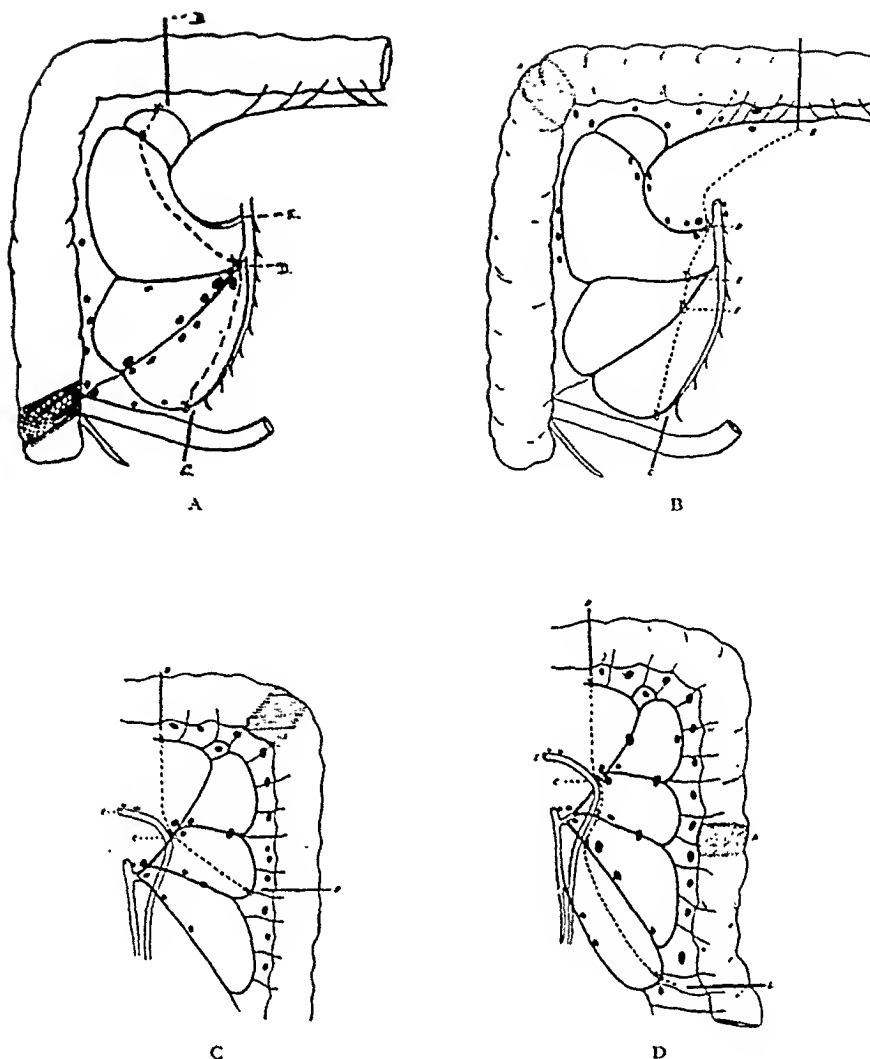


FIG. 198. Excision of colic malignancies. (From Jamieson and Dobson.)

A. Excision of cecal growth.

A, growth; B, line of section of colon; C, line of section of ileum; D, point of ligature of ileocolic artery; E, point of ligature of middle colic artery.

B. Excision of growth at hepatic flexure.

A, growth; B, line of section of transverse colon; C, line of section of ileum; D, point of ligature of middle colic artery; E, point of ligature of right colic artery; F, point of ligature of ileocolic artery.

C. Excision of growth in splenic flexure.

A, growth. B, line of section of transverse colon; C, point of ligature of left colic artery; D, line of section of descending colon; E, inferior mesenteric vein.

D. Excision of a growth in the descending colon.

A, growth; B, line of section of transverse colon; C, point of ligature of left colic artery; D, line of section of sigmoid flexure; E, inferior mesenteric vein.



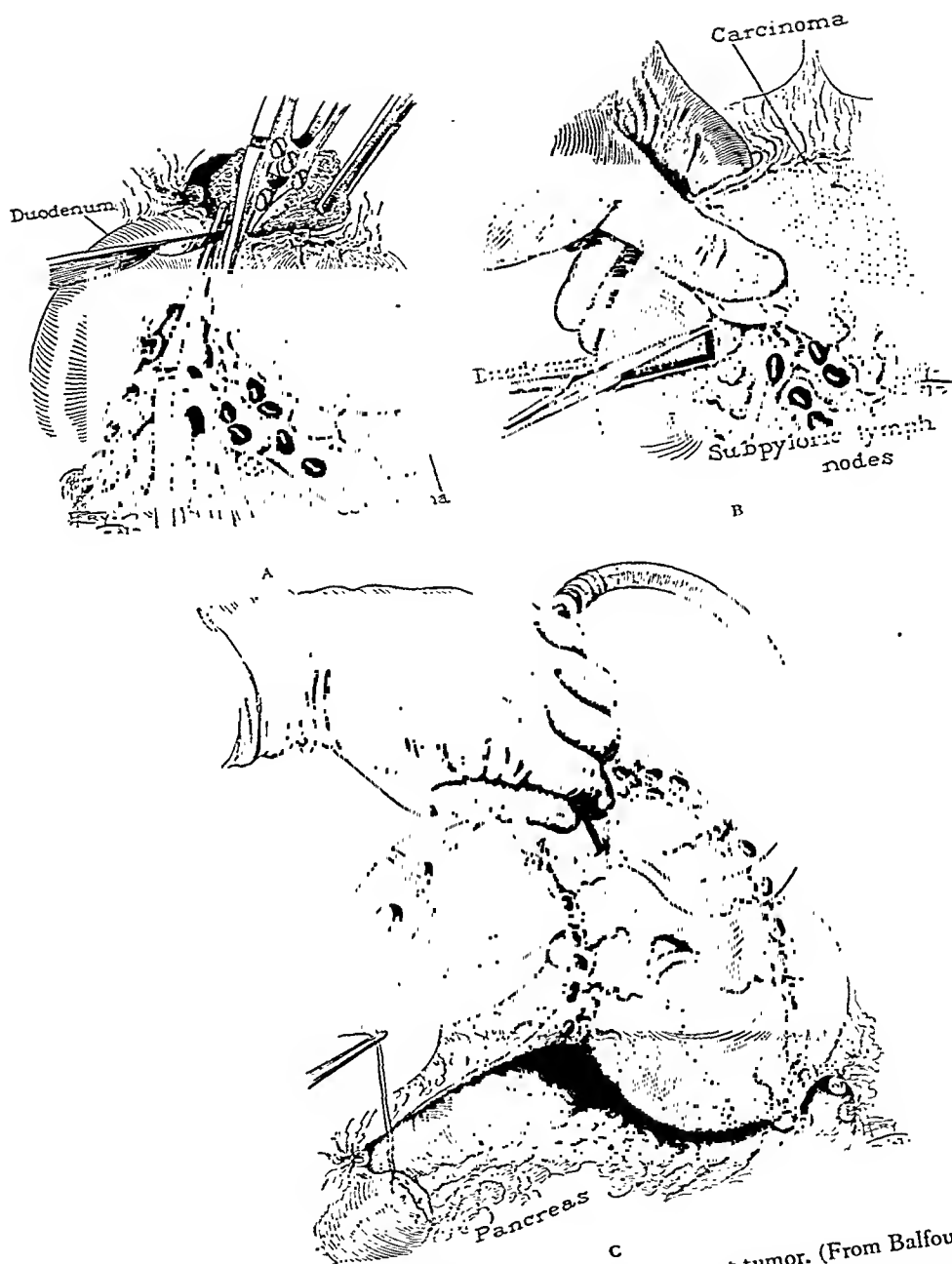


FIG. 199. Gastrectomy for excision of malignant tumor. (From Balfour.)  
 Note emphasis upon removal of gastric lymph vessels and nodes.  
 A and B show method for mobilizing subpyloric, suprapyloric, and retropyloric nodes with the stomach.  
 C shows gastroepiploic, subpyloric, retropyloric, and suprapyloric nodes, anterior and posterior left gastric nodes all being removed with gastric mass.

[540]

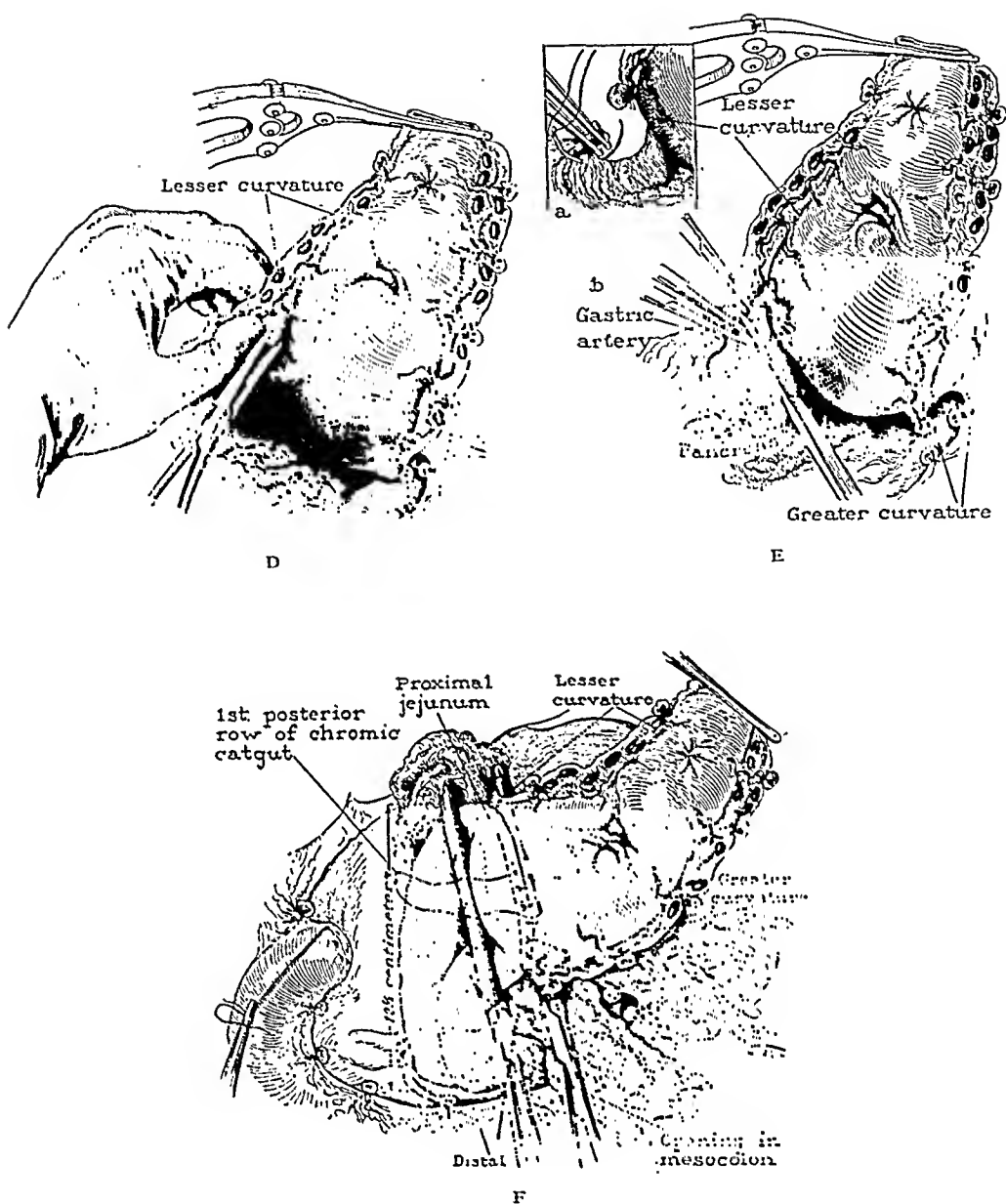
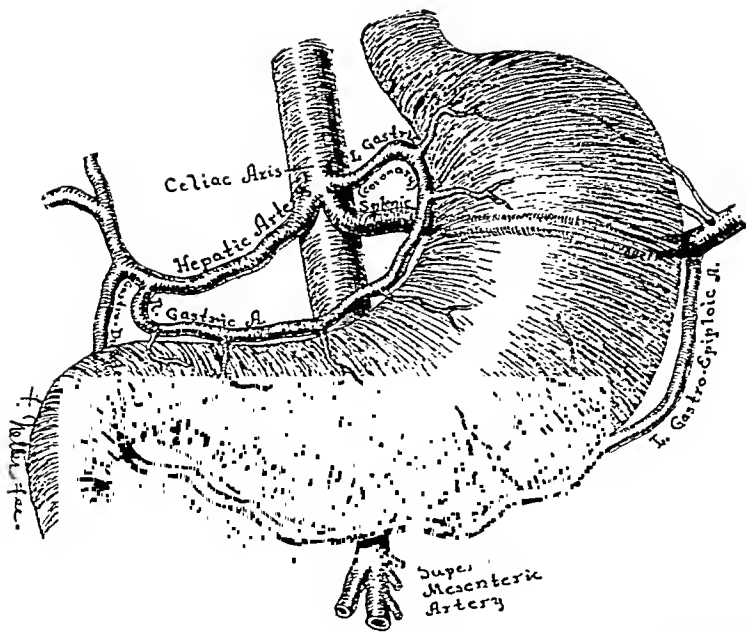


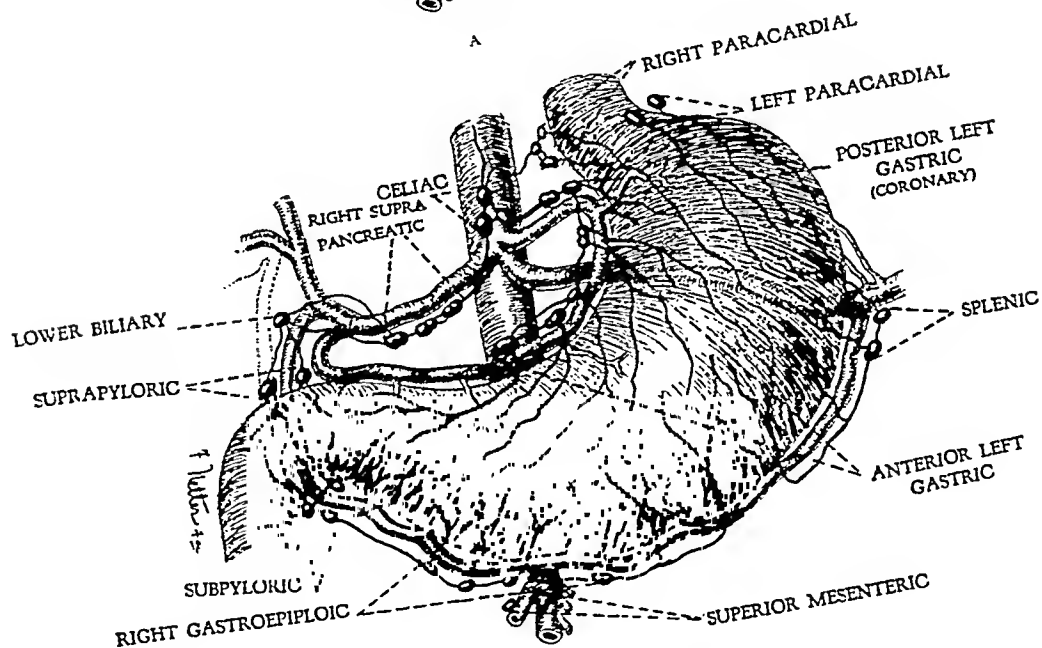
FIG. 199.

D and E. Ligation of the left gastric artery as it approaches the lesser curvature within the left gastropancreatic fold. Were ligation made along the lesser curvature the left posterior gastric glands would remain.

F. A loop of jejunum has been drawn through the transverse mesocolon and an anastomosis of stomach and jejunum (posterior Polya type) is being made prior to the removal of the malignant tissue and associated lymphatic structures.



A

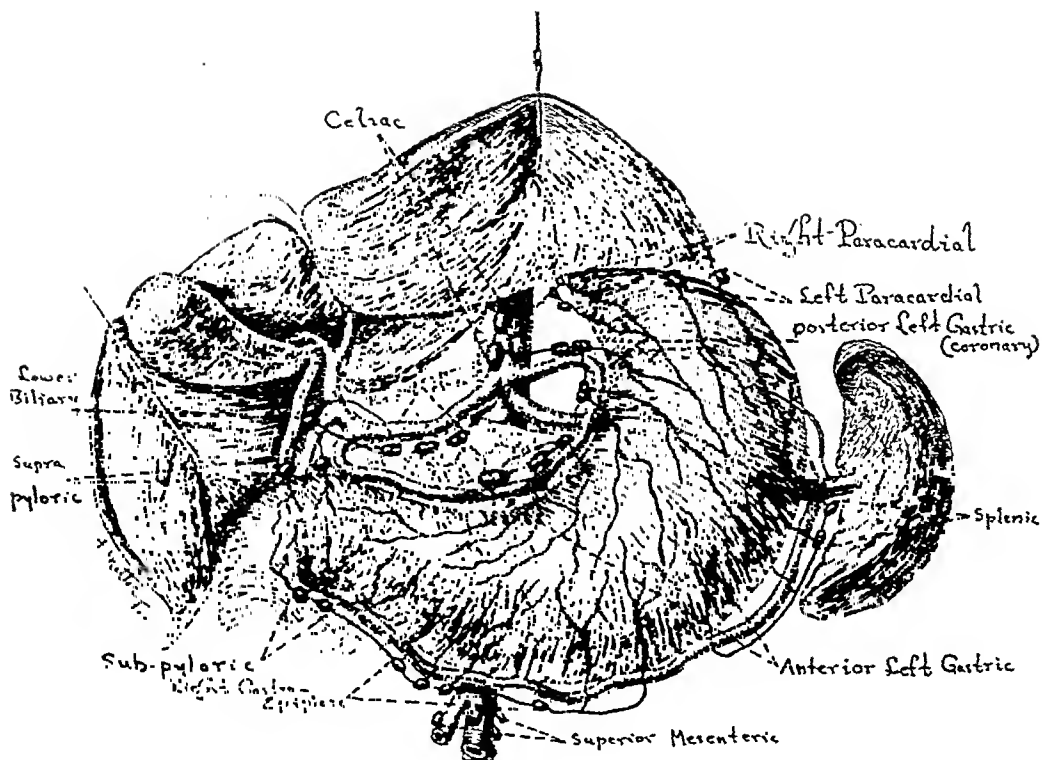


B

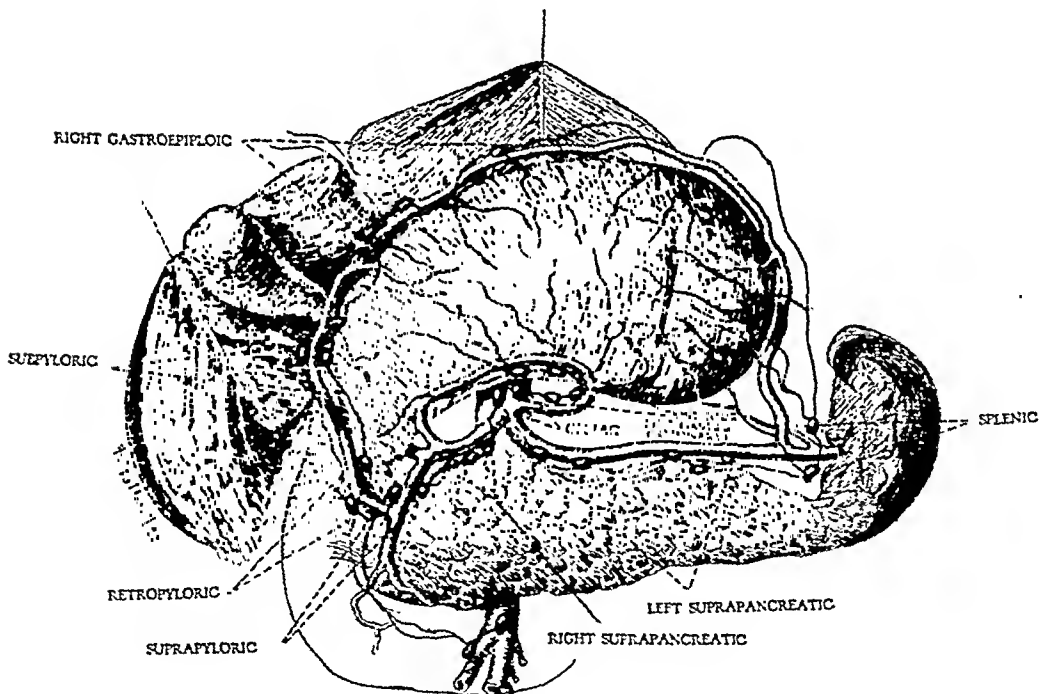
FIG. 200. A study of gastric lymph vessels and lymph nodes.  
The primary (visceral) and secondary groups of gastric lymph nodes are distributed along the branches of the gastric arteries.  
A. Anterior view of stomach and gastric arteries.  
B. Relation of lymph nodes to gastric arteries.

[542]





E



F

FIG. 200.

Figures E and F show the adjacent viscera and explain the names given the secondary gastric lymph nodes. Confusing nomenclature should not obscure the relationship between gastric arteries and gastric lymph nodes.

E. Anterior view of gastric lymphatic structures with their relationship to adjacent viscera of the supracolic division of the peritoneal cavity.

F. Posterior view of gastric lymphatic structures showing relationship of lymph nodes to adjacent upper abdominal viscera.

axis which supply the stomach with arterial blood (i.e., along right gastric artery, the hepatic artery and the splenic artery). Could one but ignore the fact that there is within the upper abdomen a liver, a pancreas, and a spleen this arrangement of the primary and secondary lymph nodes of the stomach would be extremely simple (Fig. 200a). And the gastric lymphatics could easily be described according to the method previously stated of naming first the lymph nodes associated with the visceral walls, second those along the artery or arteries supplying the viscus, and finally the large lymph node group situated nearest the origin of the artery or arteries in question (in this case the celiac cluster of retroperitoneal nodes situated about the celiac axis) (Fig. 200b). Because of the presence of pancreas, liver, and spleen, however, the secondary gastric lymph nodes take their names from their nearness to these other organs. The secondary gastric nodes, it is to be observed, serve as primary drainage nodes for adjacent viscera (Fig. 200c). Thus the secondary nodes along the gastroduodenal artery lie in anatomical relation to the terminal portion of the common bile duct and form part of the lymph node chain known as "biliary nodes." Again, the secondary gastric nodes along the hepatic artery lie in anatomic relation to the upper border of the pancreas and are therefore termed the suprapancreatic lymph nodes.

This foregoing viewpoint and explanation may, or may not, make the routine description of gastric lymphatics as stated in anatomical textbooks more readily understandable:<sup>292</sup>

The lymph vessels of the region of the pyloric canal pass (a) partly to the anterior left gastric glands, (b) partly to the right suprapancreatic lymph glands, and (c) partly to the lower biliary group of lymph glands. If the right gastric gland is present some of the vessels of the upper pyloric region go to it, and in some cases vessels from the pyloric region pass directly to the posterior left gastric lymph glands.

The lymph vessels from the right upper area of the larger portion of the stomach pass (a) to the anterior left gastric lymph glands, (b) to the posterior left gastric lymph glands, (c) to the paracardial lymph glands.

The lymph vessels from the left section of the left and lower portion of the stomach pass along the gastrosplenic ligament to the splenic glands,

which are occasionally present near the hilum of the spleen, and partly to the left suprapancreatic lymph glands.

The lymph vessels from the right part of the lower and left area follow the course of the right gastroepiploic artery and terminate in the subpyloric glands.

The practical problems are to learn what lymphatic vessels and lymph nodes theoretically should be removed in order to obtain surgical cures, and to know which of these particular structures can and which cannot, be removed with safety to life. Among recorded statements concerning the abdominal lymphatics in relation to cancer of the stomach are the following:<sup>293-296</sup>

Glandular metastasis with cancer of the stomach is of very early occurrence.

Primary gastric nodes are always involved by the time of death from cancer of stomach.

The study of gastrectomy specimens shows that in more than 90 per cent of instances lymph nodes along the lesser curvature are already involved by cancer cells at the time of operation; and that nodes along the greater curvature are involved in over 60 per cent of instances.

Malignant disease at the pylorus tends to spread toward the cardiac end of the stomach, especially along the lesser curvature.

Whereas detection of glandular involvement upon the basis of macroscopic findings (size, consistency) is often assumed to be reliable, it is known that many times the enlarged and apparently involved nodes represent simply an inflammatory lymphadenopathy.

Enlarged nodes may prove non-malignant while apparently normal nodes may, upon microscopic examination, prove to be filled with cancer cells. Hence enlargement of nodes in connection with cancer is not a reliable index of inoperability.

There is comparatively little direct lymphatic communication between the stomach and the duodenum, for, although the submucous and subserous layers of both organs are

richly supplied by lymph spaces, at the pylorus itself, because of a condensation of the connective tissue, the lymphatics are poor in character and few in number, reducing to a minimum the lymph-vascular connection between these adjacent structures.

The glandular groups which should surely be removed with a malignant growth at the pylorus are: the suprapyloric nodes, the subpyloric nodes, the retropyloric nodes, the right paracardial nodes, the nodes along the left gastric artery as it approaches the stomach within the left pancreaticoduodenal fold or *falx coronaris* (coronary nodes; left anterior gastric nodes; left posterior gastric nodes), the right gastroepiploic nodes, and the right suprapancreatic nodes.

While some lymph vessels from a primary site go to nodes immediately adjacent to the tumor, other afferent vessels from the same primary site pass directly to more distant nodes.

The left gastric artery should be ligated as it approaches the stomach rather than along the lesser curvature, in order that the important nodes along the artery within the left gastropancreatic fold may be removed en bloc with the specimen (coronary nodes; left anterior gastric nodes; left posterior gastric nodes).

The right suprapancreatic nodes are not so close to the malignant growth as they might appear in illustrations, for the pancreas is separated from the stomach by the retrogastric bursa or lesser peritoneal cavity and the lymph current must follow the course of the hepatic artery to reach the pancreatic nodes. Even when stomach and pancreas are adherent, after obliteration of the bursa omentalis, the lymphatic pathway is still chiefly along the para-arterial channels.

Involvement of the splenic lymph nodes is rare, due to the relative infrequency of malignant involvement of the cardiac extremity of the fundus; but when these nodes are infiltrated an operative cure is scarcely to be expected unless the spleen is removed together with the gastric malignant tissue.



A few glands of the subpyloric group drain secondarily along the upper border of the terminal portion of the duodenum to reach the nodes of the superior mesenteric group. Malignant extensions to these nodes, as to those immediately adjacent to the celiac axis, render the case almost certainly inoperable.

Practically the entire lymphatic drainage of the stomach ultimately reaches the celiac nodes, i.e., the upper major group of the retroperitoneal division of the intra-abdominal lymph glands.

Tuberculous involvement of the intra-abdominal lymph nodes may take the form of a localized process, a few nodes only being implicated, or of a diffuse and widespread invasion. The site of election is the ileocecal region. Here the lymph nodes drain a portion of the absorptive division of the bowel which is especially rich in lymphoid tissue (Peyer's patches). Even when involvement is diffuse it is almost always first and foremost the mesenteric nodes, rather than the lumbar or celiac nodes, which are implicated; for the gastrointestinal tract is the usual atrium for infection. Tuberculosis within the abdomen is most often of the bovine type.<sup>297</sup> The characteristics of individual tuberculous glands have already been described and explained (pale, cool, soft; see p. 513). Matting and caseation are as common within the abdomen as elsewhere. Tuberculous lymph glands are frequently associated with other forms of abdominal tuberculosis such as tuberculous enteritis, tuberculous seminalvesiculitis or salpingitis, and tuberculous peritonitis. Of the three common forms of the latter condition (serous, fibrinous, and locular or suppurative) it is chiefly the locular form in which enlarged nodes constitute an outstanding feature (Fig. 201). Caseating nodes frequently form the center of a locule. Lymph-glandular rupture is followed by a free distribution of miliary tubercles upon adjacent surfaces of bowel, omentum and peritoneum. Lymph gland involvement alone, however, is sometimes observed. This is the most mild form of intra-abdominal tuberculosis.

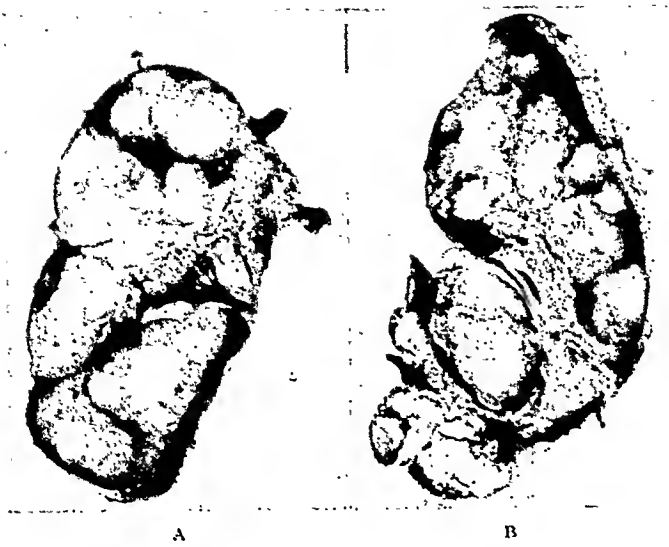


FIG. 201. Tuberculosis of abdominal lymph nodes.

- A and B. Caseating tuberculous lymph glands. (From Edmunds.)  
 C. Giant cells within a tuberculous lymphatic gland. (From Edmunds.)  
 D. Caseating tuberculous lymphadenoma. (From Edmunds.)

Spontaneous recovery, it is said, may be anticipated in more than 50 per cent of cases of this condition.<sup>298</sup> Lymph node tuberculosis, when more advanced and serious in character has been

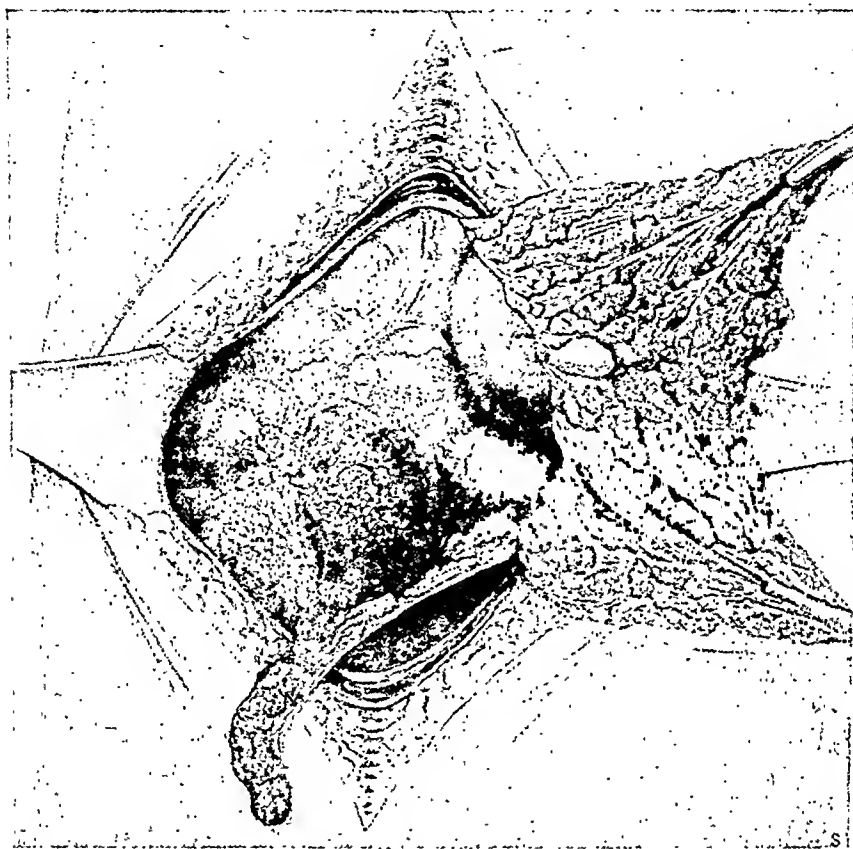


FIG. 201.

E. Acute miliary ileocecal tuberculosis. Enlargement of mesenteric lymph nodes is an important part of the pathological picture with this condition. The great omentum (drawn out of wound) contains innumerable miliary tubercles. (From Hertzler's *The Peritoneum*, Mosby.)

termed *Tabes Mesenterica* (from *tabes*, a wasting). The terms *tabes mesenterica* and *tabes dorsalis* are not to be confused. With *tabes dorsalis* the wasting is due to involvement of the posterior spinal columns and posterior root ganglions, the cause being usually, if not always, syphilis. But in *tabes mesenterica* the wasting is an expression of

malnutrition from interference with normal fat absorption by way of the lymph vessels; it is an index also of toxic absorption caused by the action of the tubercle bacilli upon the tissues

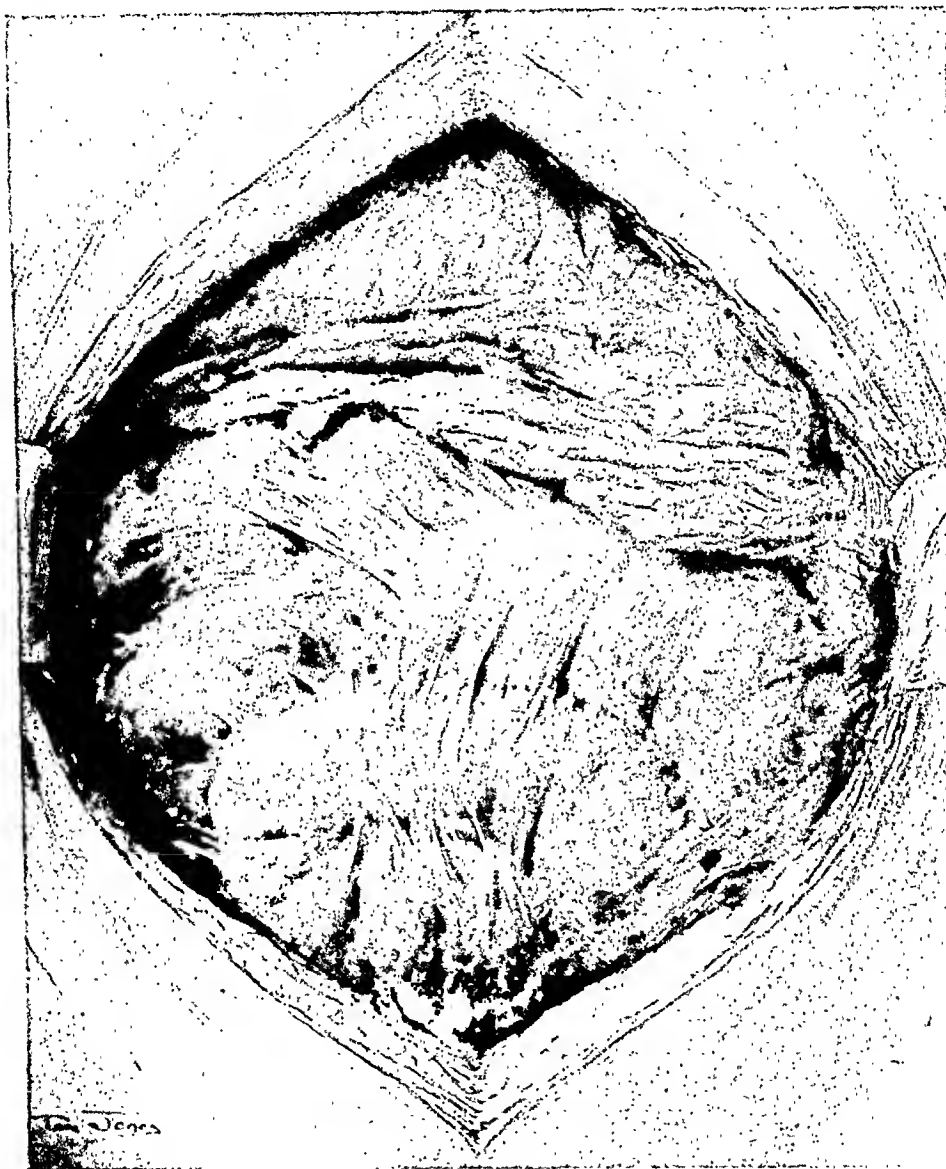


FIG. 201.

r. Fibroadhesive tuberculous peritonitis. Rupture of tuberculous mesenteric lymph nodes may lead to such an extensive or generalized pathological process. (From Hertzler's *The Peritoneum*, Mosby.)

of the host, an action which causes typical emaciation with tuberculous processes as they occur in any part of the body (consumption, to use up or waste; phthisis, a wasting).

The clinical picture of tuberculosis of the mesenteric lymph nodes is variable and vague. Signs and symptoms are due in part to pressure effects on nerves, vessels and intestinal loops, produced by the enlarged glands. Pressures on veins produce, at times, slight edema of one or both ankles, visible engorgement of the superficial epigastric or superficial circumflex iliac vessels; even the hepatic vein may be partially obstructed, with a resulting tendency to a light jaundice; or the portal vein may be implicated by a node near the porta hepatis, yielding some degree of ascites and of visible stasis within the anterior abdominal wall veins of the portal collateral set. Pressures on afferent sensory nerves may account for the frequently complained-of sensation of abdominal fullness, or for a positive discomfort within the belly, made worse, perhaps, by walking or jarring. And the involvement of efferent motor nerves may initiate secretomotor irritative phenomena within the gastrointestinal tract. Among these are, diarrhea, nausea, vomiting and dyspepsia. Pressures directly upon intestinal loops give rise, at times, to evidences of low-grade mechanical obstructions of the bowel; increasing constipation, flatulence, intermittent attacks of colicky pain. Normal functions of the involved nodes are interfered with, and loss of weight, loss of strength, loss of appetite, and loss of general health insidiously develop. Vague masses, consisting partly of the caseous or matted nodes and in part of adherent intestinal loops, may be palpable within the abdomen. These soft, pseudotumors, if present, are sometimes palpable rectally or vaginally as well as abdominally. Thomayer's sign is often present.<sup>299</sup> The spleen may be found slightly or moderately enlarged. An umbilical induration, as a chronic hydrocele, leads to a suspicion of a tuberculous peritonitis; unusual pigmentation of the skin or buccal mucous membrane suggests the presence of an associated adrenal involvement; a chronic non-specific urethral discharge may imply the presence of a concomitant tuberculous seminal vesiculitis.

To summarize: with any chronic, vague, abdominal complaints of insidious onset occurring in children or young adults, the possibility of an intra-abdominal tuberculous lymphadenitis or of a tuberculous peritonitis should be considered. The suspicion as to the presence of a tuberculous process is strengthened when there are evidences of mild venous blockage, of vasomotor gastrointestinal irritative phenomena, or of low-grade mechanical obstructions of the bowel. Soft pseudotumors or small amounts of free fluid, when also present, indicate the diagnosis. And when such findings occur in patients having a history of familial tuberculosis, or with a history or evidences of a tuberculous process at any other point within the body, the diagnosis becomes presumptive. The combination of a secondary anemia and a low-grade lymphocytosis is evidence of a confirmatory nature; and the added finding of a persistently rapid pulse, a slight daily temperature with regular diurnal variations, may be considered diagnostic.

There seems little question as to the efficacy of surgical intervention in selected cases of intra-abdominal tuberculosis. Removal of even a portion of the involved lymph glands has often been followed by a prompt and striking gain in weight and an alleviation or disappearance of the preoperative evidences of the disease. This has been explained as due to a turning of the tide in the combat between the invasive powers of the organism and the defensive powers of the host. Clinical cures following laparotomies for the drainage of tuberculous ascitic fluid are numerous and the causal relation of the operation in obtaining these cures has been presented as certain. Since the first report by König<sup>300</sup> of a cure following operation, surgical treatment for intra-abdominal tuberculous conditions (ileocecal tuberculosis; tuberculous peritonitis; tuberculous mesenteric lymphadenitis) has been placed upon a sound footing.<sup>301, 302</sup> While it is known that operations often fail to remove all tubercle bacilli or tuberculous lesions, it has been suggested that not only is the virulence-resistance balance frequently turned in favor of the patient, but that the

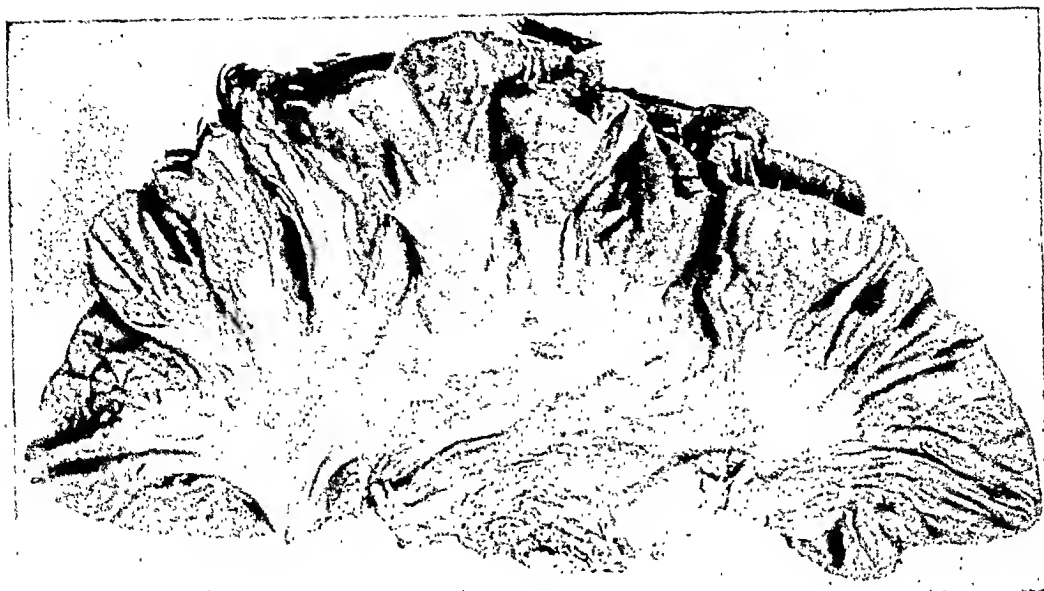
mere opening of the peritoneal cavity stimulates an outpouring of fresh serum and initiates a renewed local protective response.<sup>303</sup> Notwithstanding the value of surgery in selected



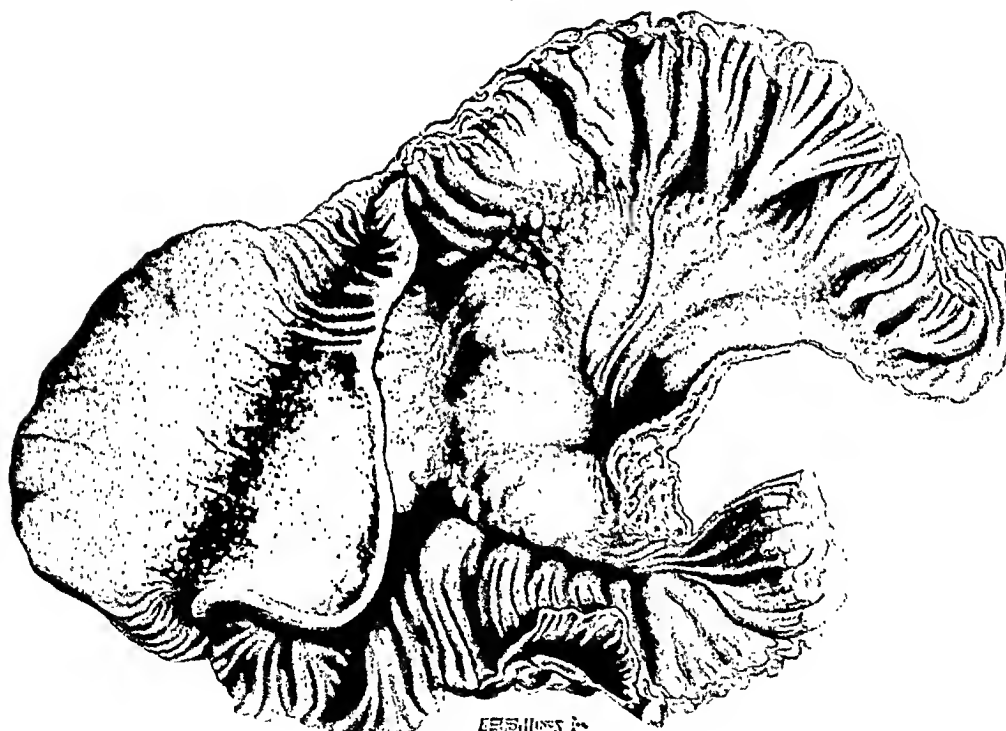
FIG. 202. Malignant lymphadenoma (Hodgkin's). Gland cut open to show the granular appearance produced by the increase in the fibrous tissue. Compare [with tuberculous lymph glands in Figure 201. (From Edmunds.)

cases the basis for the treatment of tuberculosis within the abdomen, as elsewhere, is hygienic, dietetic, and heliotherapeutic care. Prolonged rest and medical supervision are essential for cases of surgical as well as for those of non-surgical tuberculosis.

Many of the signs and symptoms of tuberculous lymphadenitis may be caused by one of the essential lymphadenopathies. Vast leucemic nodes may give rise to a clinical picture which closely resembles that of tabes mesenterica. The additional presence, however, of enlarged superficial nodes throughout the body, of a large hard spleen, and of an unusually high lymphocytosis should leave little reason for errors. Leucemic glands tend to be general as to their intra-abdominal distribution<sup>304</sup> for the condition is a systemic disease and since the intestinal canal does not act as an atrium for infection, the mesenteric nodes do not tend to predominate. Lymphosarcoma has previously been discussed in pages dealing with intestinal



A



B

FIG. 203.

A. Enlarged mesenteric lymph nodes from a case of status lymphaticus in which death occurred during the administration of an anesthetic. The enlarged lymph glands are seen standing out within the mesentery. A large mass of lymph glands is present near the mesenteric root. (From Edmunds.)

B. Lymphocytoma of the ileum and mesenteric glands (leucemia). (From Osler and McCrae's Modern Medicine.)

[555]



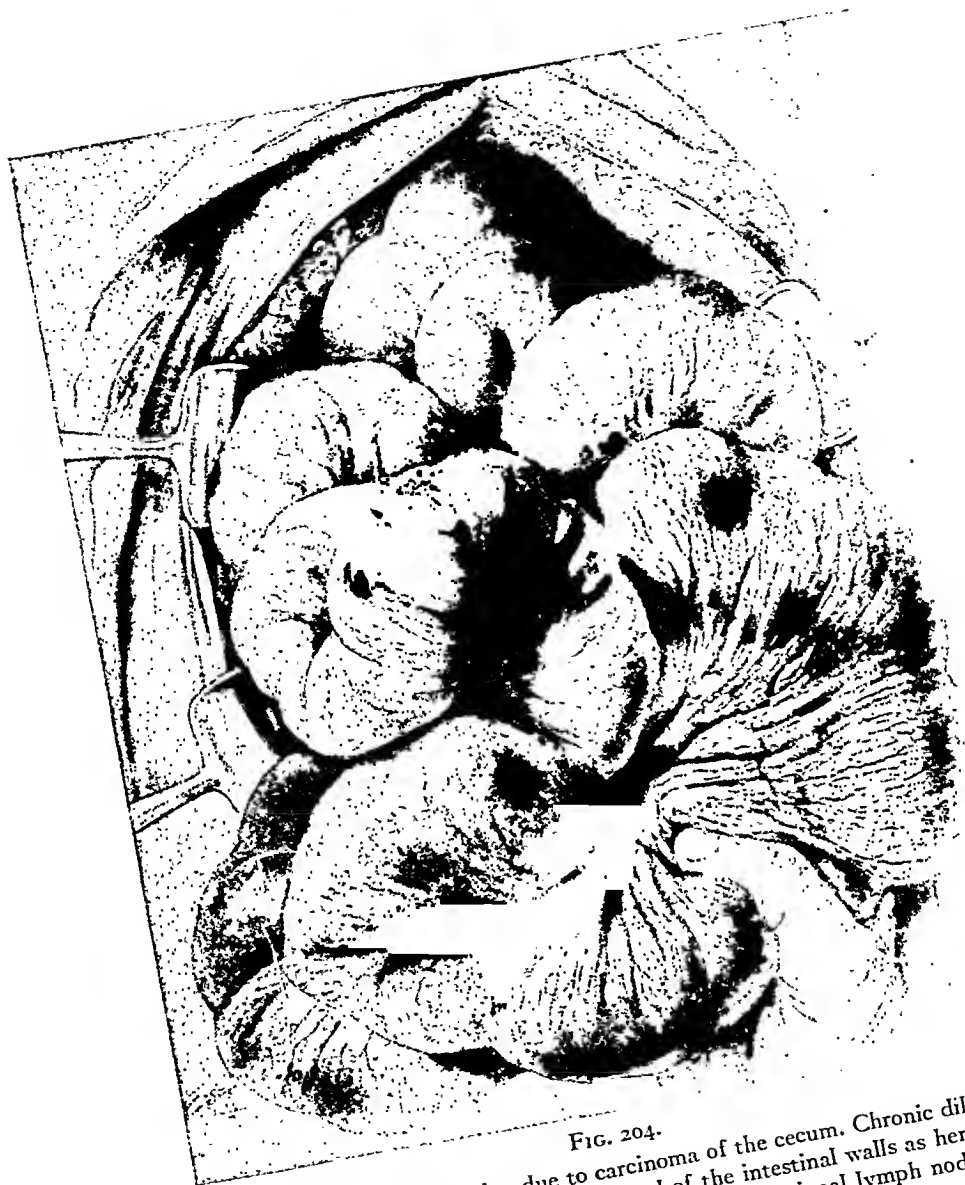


FIG. 204.

Case of intestinal obstruction due to carcinoma of the cecum. Chronic dilatation of blood and lymph vessels of the mesentery and of the intestinal walls as here pictured is often the result of secondary malignant deposits in regional lymph nodes. Among evidences of enlargement of mesenteric lymph nodes from any cause are: signs and symptoms of chronic intestinal obstruction, gastrointestinal secretomotor irritative phenomena, and chronic dilatation of superficial anterior abdominal-wall veins. (From Hertzler's *The Peritoneum*, Mosby.)

obstruction (p. 411) and with retroperitoneal tumors (p. 278). Hodgkin's disease may closely simulate tuberculosis of the abdominal nodes; for, contrary to usual textbook descriptions, Hodgkin's disease is not preeminently an affection of the cervical region; and as has been shown by Symmers<sup>305</sup> in a study of the distribution of enlarged nodes as found at autopsy, Hodgkin's disease more often effects first and with greatest intensity the mesenteric, retroperitoneal, and mediastinal lymph glands (Fig. 202). But with this form of malignant lymphoma there soon occurs extension to superficial lymph node groups; and the absence of a history of familial tuberculosis or of tuberculous lesions elsewhere in the body, the presence of the Pel-Ebstein rather than of the hectic type of temperature reaction, and the fact that locally the nodes do not caseate or become matted with Hodgkin's disease, all are important points in the differential diagnosis.<sup>287</sup> Primary malignant endotheliomata of the abdominal lymph nodes, both in a localized and a generalized form, have been reported<sup>288</sup> but the discovery of the endotheliomatous nature of the nodes, as is the case in identifying so-called pseudo-leucemic tumors, must rest with the pathologist and in general because of the similarity of the essential lymphadenopathies to one another and to other intra-abdominal lymphatic affections, the surgeon is best fortified against the late discovery of diagnostic errors by making it a rule to submit to biopsy a specimen gland in every instance in which doubt remains in his mind as to the true cause of any lymphatic enlargement which he encounters.

## QUESTIONNAIRE

1. What are the practical questions which should come to the surgeon's mind when he encounters enlarged intra-abdominal lymph nodes during the course of a laparotomy?
2. What are afferent lymph vessels? Efferent lymph vessels?
3. What characteristics should be especially noted about abnormal lymph nodes encountered during laparotomies?
4. Describe the general distribution of lymph nodes within the abdomen.
5. What are the major groups of intra-abdominal lymph nodes?
6. What are visceral lymph nodes? Retroperitoneal lymph nodes?
7. Describe the mesenteric group of lymph nodes.

8. Describe the lumbar lymph nodes. What are the areas drained by these nodes? In what way do lumbar nodes drain into the cisterna chyli?
9. Describe the celiac lymph nodes. What is their drainage area? In what manner do the celiac nodes drain into the cisterna chyli?
10. State in a general way the method by which the lymph vessels and lymph nodes associated with specific abdominal organs may be described.
11. What are the 5 most common lymphatic diseases of intra-abdominal lymph nodes?
12. What is meant by "sentinel" lymph nodes?
13. What is the location of the cystic node, the appendicular node, the right gastric node?
14. Where are the so-called Troisier nodes located? State their significance in abdominal disorders.
15. How do lymph nodes become secondarily involved from intra-abdominal malignancies?
16. What is meant by lymph permeation?
17. Describe proved routes of extension through lymph permeation from cancer of the breast.
18. Describe extension of lymph permeation into the abdominal cavity from an extra-abdominal malignancy; state the specific lymphatic pathways.
19. What is a malignant embolus?
20. Describe various ways by which primary malignancies within the abdomen may spread to remote regions within the body.
21. Explain blood stream invasion by malignant emboli which have traversed the thoracic duct.
22. How may the surgeon know exactly what lymph nodes and vessels are likely to be first involved by extensions from a primary malignancy of any specific organ?
23. Name two factors which indicate the necessity for wide excision of tissue about malignant growths.
24. Do all lymph vessels draining a primary malignant neoplasm pass to the lymph nodes situated nearest the growth?
25. What is meant by aberrant malignant implantations?
26. What lymph nodes should be removed during the excision of an ileocecal carcinoma? What large vessels require ligation in this operation?
27. Describe in general terms the factors which have been taken into consideration in regard to accepted radical operations for the removal of gastrointestinal malignant neoplasms.
28. What is meant by the statement "the surgery of gastrointestinal malignancies is the surgery of the gastrointestinal lymphatic system"?
29. What is the most common site for malignant growths in the male?
30. Describe the gastric lymph nodes.
31. What is meant by primary gastric nodes; secondary gastric nodes?
32. What is the relation, as to location, between gastric lymph nodes and gastric arteries?
33. Draw a diagram of the stomach and place upon this diagram the following lymph nodes or lymph node groups: the anterior left gastric glands; right suprapancreatic glands; lower biliary lymph glands; posterior left gastric lymph glands; the right and left paracardial lymph glands; the splenic nodes; left suprapancreatic nodes; subpyloric nodes; right and left gastroepiploic nodes.
34. Is glandular metastasis an early or a late occurrence with gastric carcinoma?
35. Give grounds for and explain answer.
36. Is secondary lymph glandular involvement with gastric carcinoma more common along the lesser or greater curvature?

37. Does or does not the presence of enlargement of gastric lymph nodes with gastric carcinoma mean that malignant metastasis has occurred?
38. Is the presence of enlarged nodes in connection with cancer a reliable index to be taken into consideration in determining the operability or non-operability of the growth?
39. At what points should the left gastric artery be ligated during a resection for gastric carcinoma?
40. When the splenic lymph nodes are enlarged with a gastric malignancy is the case operable or inoperable?
41. Does extension to lymph nodes about the celiac axis or superior mesenteric artery render a gastric carcinoma inoperable?
42. What is *tabes mesenterica*?
43. What is the meaning of the word *tabes*?
44. What is the location and nature of the pathological process with *tabes mesenterica*, with *tabes dorsalis*?
45. What is the most common site for an intra-abdominal tuberculous lymphadenopathy?
46. What is the usual gross appearance of abdominal tuberculous lymph glands?
47. What are common sites of tuberculous involvement found to be associated with tuberculous abdominal lymph glands?
48. What are some of the causes of wasting or emaciation with tuberculosis?
49. Describe in a general way the mechanisms by which symptoms are produced with tuberculosis of intra-abdominal lymph glands.
50. Describe some of the evidences of venous obstruction with intra-abdominal tuberculosis.
51. What is Thomayer's sign?
52. Explain the so-called pseudotumors sometimes observed with intra-abdominal tuberculosis.
53. Discuss methods for arriving at a diagnosis of tuberculosis of intra-abdominal lymph nodes.
54. Discuss surgical treatment for intra-abdominal tuberculous processes.
55. Give possible explanations for surgical cures obtained from operations for intra-abdominal tuberculosis in which not all tubercle bacilli or tuberculous lesions have been removed.
56. Discuss postoperative treatment for tuberculosis patients.
57. What is meant by primary or essential lymphadenopathies?
58. Discuss leukemia with special reference to the involvement of intra-abdominal lymph nodes.
59. Discuss abdominal lymphosarcoma.
60. Discuss the distribution of involved lymph glands in Hodgkin's disease.
61. Discuss the diagnosis of primary malignant endothelioma of the abdominal lymph nodes; of intra-abdominal pseudoleukemic tumors.
62. When is it advisable to submit abdominal lymph nodes to biopsy?

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## AUTHOR'S NOTE

With the completion of this chapter dealing with Abdominal Lymphatics the serial publication of "A Clinical Study of the Abdominal Cavity and Peritoneum" comes to an end. The material covered in the issues of

THE AMERICAN JOURNAL OF SURGERY from January to December 1930 constitutes, with the addition of a chapter on Visceral Neurology and certain practical diagnostic charts, the first volume of this postgraduate review.

This volume covers the following headings: A, The Empty Cavity and B, The Gastrointestinal Tract. There remain for consideration in a subsequent and companion volume: C, The Solid Organs, and D, The Peritoneal Membrane.

## EPONYMIC STUDIES: DUCTS OF THE PANCREAS

1. Wirsung, Johann Georg ( —1643). A German anatomist in Padua.
2. Santorini, Giovanni Domenico (1681–1737). (L. Jo. Dominici.) An Italian anatomist in Venice.
3. Vater, Abraham (1684–1751). A German anatomist at Wittenberg.

## JOHANN GEORG WIRSUNG (vēr'soong)

The main pancreatic duct, draining the entire length of the pancreas and joining the common bile duct to empty into the duodenum.

Bavaria. Town and date of birth unrecorded. Death, 1643.

*Figura ductus ejusdam cum multiplicibus suis ramulis voviter in pancreate in diversis corporibus humani observatis*: Padua, 1643. (In folio.)

Wirsung's original observations are recorded on a single rare copper plate. (Garrison's *History of Medicine*. Ed. 4, Saunders, 1929, p. 250.)

An interesting legend concerning Wirsung's discovery and the supposed relation of this to his death is related in the following brief biographical sketch (Sir M. Foster's *Lectures on the History of Physiology during the Sixteenth, Seventeenth, and Eighteenth Centuries* published in 1901 by the Cambridge University Press, as one of the Cambridge Natural Science Manuals).

"The first step was taken by John George Wirsung, who though a Bavarian by birth, held in the middle of the seventeenth century the once so famous chair of Anatomy at Padua. In a letter to Riolan dated 1643, he described the duct of the pancreas which he had discovered the year before. He speaks of its entrance into the duodenum close to the mouth of the biliary duct, and of its ramifications in the body of the pancreas. He says that he found it easy to pass a style through from the body of the gland into the duodenum, but difficult to pass the style from the duodenum into the duct, that the duct is present in man at all ages, that he found it in all the animals which he had examined, and that it could not be either an artery or a vein, since it never contained blood, but on the contrary was often filled with a nearly colourless liquid which like bile stained a silver style.

"Wirsung's pupil John Maurice Hofmann claimed the discovery as his own, as one made by himself and laid hold of by his master; but there is no satisfactory evidence of this. Wirsung met with a tragic death [same year], being shot as he was entering his house at night; the legend states that a quarrel about the discovery of the duct was the cause of the murder, but it seems to have been the result of some private grudge." (p. 104.)

## TRANSLATION OF SANTORINI'S "TABLE XII"

The duodenum, in which the most important factors [shown] are the liver, the gall-bladder, the outlet, site, form, and number of the pancreatic ducts, and the disposition of the principal folds or rugae.

A. Lowest part of stomach excised from remainder, and at the same time dissected lengthwise with the pylorus and the duodenum, and spread out . . .

B. Part of the hepatic duct cut in two and stretched out, in which is found (b) a single mouth from branches which converge from the liver into this duct.

E. Part of the gallbladder is at the near end of the cervix, very flexuous, after the main bend of which at length it is led into (cc) a twin slender duct with numerous but short windings. This duct (d) terminates at a narrow opening in the hepatic canal; and then this canal.



*The Property of the New York Hospital.*

# OBSERVATIONES ANATOMICÆ

JO: DOMINICI SANTORINI.

*Supremi MAGISTRATUS salutis Venet. Protomedici,  
& in Veneto LYCEO Anatomes Professoris.*

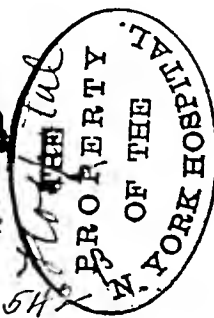
PETRO I. MAGNO  
IMPERATORI,

Totiusque Magnæ, Parvæ, & Albæ Rusciæ AUTOCRAT-  
TORI, Magno Duci Moschoviæ, Chioviæ, Uladi-  
miriæ, Novogradæ, CZARo Casani, &c.

D. D. D.

*n<sup>o</sup> 354*

*New York*



LUGDUNI BATAVORUM,

Apud GYSBERTUM LANGERAK, 1739.

FIG. 205A. Title page of Santorini's "Observationes Anatomicæ."

JO: DOMINICI SANTORINI  
ANATOMICI SUMMI  
SEPTEMDECIM TABULAE

QUAS  
NUNC PRIMUM EDIT ATQUE EXPLICAT  
IISQUE ALIAS ADDIT  
DE STRUCTURA MAMMARUM  
ET  
DE TUNICA TESTIS VAGINALI  
MICHAEL GIRARDI

IN REGIA PARMENSI UNIVERSITATE ANATOMES  
PROFESSOR PRIMARIUS  
ET CAESAR. LEOPOLD. CAROL. ACAD.  
NATUR. CURIOS. SOCIUS.



LB

PARMAE

EX REGIA TYPOGRAPHIA  
CIO. MDCC. LXXV.

FIG. 205B. "Seventeen tables of anatomy," by Jo. Domenicus Santorini, now edited and explained for the first time and to which are added "The structure of the breasts" and "The tunica testis vaginalis" by Michael Girard, head professor of anatomy in the Royal University of Parma, and fellow of the Emperor Leopold Charles Academy of Natural Curiosities. Parma: The Royal Press, 1775.

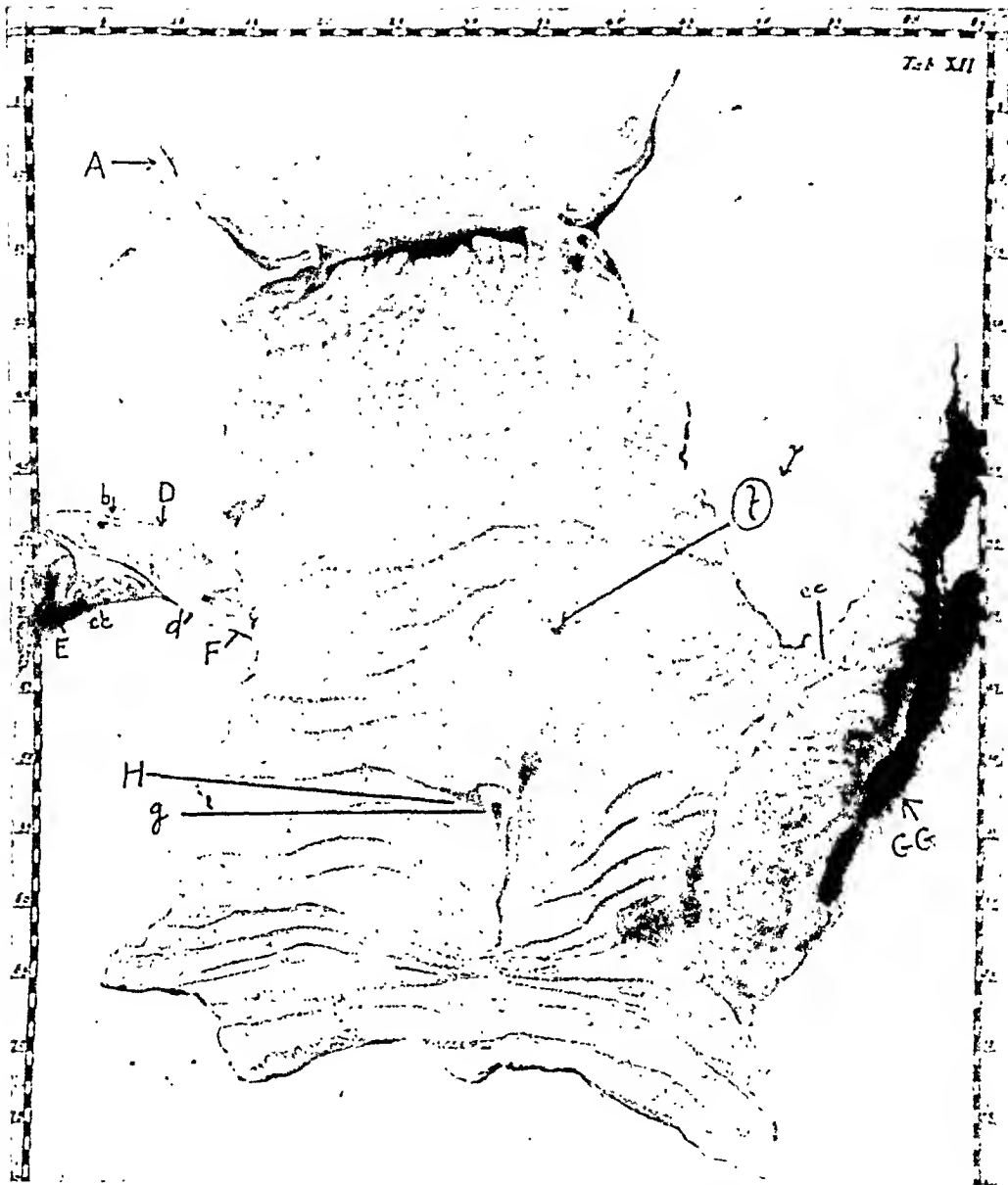


FIG. 205c. Photostatic copy of Santorini's Table XII. (Note: the letters of identification are not those of the original but have been added.)



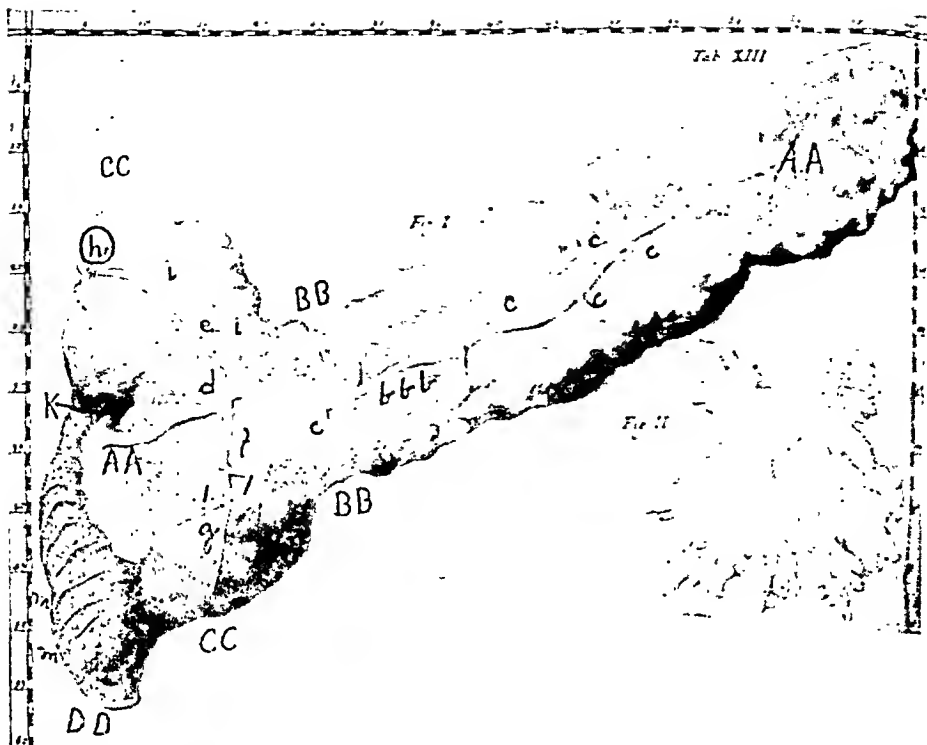


FIG. 205E. Photostatic copy of Santorini's Table XIII. (Note: the identifying letters did not appear on the original plate as here shown but have been added.)

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## TABULA XIII.

### FIGURA I.

Exhibet pancreatis naturalem magnitudinem, formam, habitum, & obliquum positum, quemadmodum fore suis in sedibus constituitur, atque in longitudinem ita scissi, ac deducti, ut omnis ductus ejus, exitusque in conspectum veniat, itemque portiunculam intestini duodeni pancreati adnexam, ac in longitudinem dissectam, & revolutam.

- AA** Pancreatis longitudo omnis, atque latitudo.  
**BB** Pancreatis pars tenuior, angustiorque, cervice a me truncata, subter quam pars plurima arteriarum, venarum, nervorum, ac lymphæ ductuum ad mesenterium pertinentium feruntur, eaque Tab. n.® indicatur.  
**CC** Pars altera ipsius pancreatis dexterior in latitudinem ducta, quæ in gibbum composita, intestino duodeno adnectitur, cujus latera transversæ accessionis amplitudo nulla hætenus in Tabula descripta fuit.  
**aa** Extremæ radicales sunt.  
**bbb** Ductus, qui per medium pancreas flexuoso tractu ab uno ad alterum extremum ad intestinum usque duodenum oblique deferuntur.  
**ccc&c** Complexus varique ramusculi, qui in medium hunc ductum conflunt.  
**d** Longior, & plenior varique aliter ductus, qui in ductum medium pariter corrivatur.  
**e** Superior nempe, &  
**f** Inferior: ex gemino, inferiore scilicet, & superiore ductus unus transversus pene conflatur. cujus  
**g** Principium in ima transversa pancreatis accessione est.  
**h** Terminus autem, exitusque, qui in intestinum duodenum per earumculam Tab. XII. lit. f. descriptam secretum humorem vehit.  
**iii&c** Propagines majusculæ ramorum, quæ ab lateribus in utrumque hunc transversum ductum concurrunt, quæ ab transversa pancreatis accessione radicales trahunt.

FIG. 205F

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Quamquam Graafius, (a) qui accuratius caeteris Spartam hanc excoluisse videtur, duplicis pancreatis ductus indicium praeberit, & post ipsum Winslowus (b), alique, ac in iis potissimum Summus Hallerus (c) propriis quibusdam characteribus hunc ductum ornaverint; nihilo tamen secius Santorinus hac Tabula, dum cum pancreatico ductu alterum transversum exhibet, nisi inventionem, elegantiam certe, atque sedulitate decessoribus palmam praeripuisse videtur. Dum enim Graafius, ut caeteros brevitaris gratia praeteream, duplicem pancreatis ductum (quorum alterum interdum ut a majori prorsus sejunctum, ita & penitus defuisse observavi) scriptis indicat, in Tabula tamen I., quam ipse exhibet, ne indicium quidem alterius hujusce ductus aut delineatione, aut verbis ostendit: immo cum postremum furculum ductus pancreatici, qui huic Santorini transverso ductui respondet, ac reliquos pancreatis furculos lit. B designaverit, illum non pro peculiari ductu, sed cum reliquis furculis communem habuisse, aperitissime evincitur. *Hic vero pancreatis alter ductus, cum in transversum pene positus sit, ejusque tenuis origo ab imis latioris transversae accessionis partibus procedat, complurium ramusculorum confluentibus, ad eum ductum, qui secundum longitudinem est, sese conferre, atque in illum insuit: protinus autem ex adverso ipsius lateris eadem prope latitudine emergit, ac in superiora sese propiciens, in itinere furculorum accessione auditus, post levem curvaturam, laeis circiter duobus digitis supra longioris ductus ingressum, duodenum intestinum subit. Id hujus ductus iter, ac incessus est: de quo tamen non ita intelligo quasi humor ab imo delatus in transversum per eum, qui secundum longitudinem defluit, in superiorem partem contendere debeat; sed ita accipi volo, quasi unus transversus ductus esset, tamen si (quod rationi maxime congruit) humor ab inferiore delatus in longitudinem, qui vero per longiorem delabitur, partim recta, partim in transversum per hunc minorem ductum procedat. Forma autem, colore, tenuitate, humore alteri prorsus similis: brevior*

(a) Regneri de Graaf. Opera omnia. Lugduni an. 1678. De Succo pancreatico Cap. 1.

(b) Traité du bas-ventre n. 324.

(c) Elem. Phys. Lib. xxii. §. vi.

### TABULAE XIII.

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tamen est, & angustior; cisi aliquando amplissimum ipsius exitum viderim. Ut ductum hunc constantissime conperi, ita frequentissime in longiorem influentem, aut, si iubet, effluentem dicere adveni, ut alterutro inflato, sicuti etiam habet Graafius, uterque statim attollatur.

- k Ductus choledocus, seu communis, qui circumfusus pancreatis, natura sui loci deserta, quo ille in conspectum veniat cum extremo majoris ductus pancreatis corrivatur, quocum pariter per majorem, inferioremque carunculam Tab. XII. lit. H in duodenum terminatur.
- DD Perio intestini duodeni, quod propter pancreatis oram secundum longitudinem incisum, atque inversum,
- mm Valvulas, seu rugas, &
- \*\*\* Sec. Glandulas proferet.

FIG. 205F. (Continued)

r is called the bile duct, or common duct, said to be inflated by the cystic and hepatic, whose union is such that it is one with the pancreatic duct and common opening in the duodenum, for the most part.

GG. Pancreas—shown as far as the limits of the table permit—, whose more accurate structure, form, and site are shown in the following tables.

(cc) Pancreatic duct and its branches.

(f) A caruncula almost conic in form, in whose extreme slender vertex is seen the upper outlet of the pancreatic duct, through which we insert sometimes a hair (seton), sometimes a stylus (probe) without difficulty.

n. Major caruncula, in the middle of which (g) is a conspicuous oblong opening, which is the sole outlet of the common bile duct coming from the liver, and from the gallbladder, and major ducts of the pancreas, too. Moreover, this caruncula, almost the width of the thumb in length, in the more left part of the duodenum, located longitudinally, slightly flexed in an arc, following the slight curvature of the duodenum, very prominent on its own part, proceeding half between the membranes of the intestine, with a rounded protuberance, almost like a reed pen for writing, bears in its locations a certain resemblance to a slightly curved cylinder.

## TRANSLATION OF SANTORINI'S TABLE XIII

FIGURE 1

This shows the natural size, the form, the appearance, and the oblique position of the pancreas, how it is constituted almost in its own locations, both cut lengthwise and stretched out, so that its whole duct and outlet are visible; and it likewise shows the part of the duodenum which is attached to the pancreas, both longitudinally dissected and turned back.

AA. The full length and breadth of the pancreas.

nn. The more slender and narrower part of the pancreas, which I have called the cervix (neck), under which are carried to the adjacent mesentery the majority of arteries, veins, nerves, and lymph ducts, indicated in the table.

cc. The other part of the same pancreas, carried more to the right in latitude, which, shaped like a hump, is attached to the duodenum, whose great width of transverse increase (approach) has not so far been described in a table.

(aa) These are the ends of the radícula.

(bbb) A duct which runs obliquely through the middle of the pancreas in a winding tract from one end to the other, as far as the duodenum.

(ccc and c) Several little branches on both sides, which branches converge in the middle of this duct.

(d) On both sides a longer and fuller duct, which is likewise conducted into the middle of the duct: (e) above, certainly, and (f) below: from the double duct (namely, the lower one), and from the upper duct one transverse one is nearly produced, whose (g) beginning is in the lowest transverse increase (approach) of the pancreas. (h) Moreover, the end and outlet, which carries a secret humour into the duodenum through the caruncula described under letter f of table XII.

(iii et cetera) Somewhat larger branches, which cross this transverse duct from the sides, which bear radiculæ from the transverse increase (approach) of the pancreas.

DISSERTATIO ANATOMICA IV  
*2VA*  
NOVVM  
BILIS  
DIVER TICVLVM  
CIRCA  
ORIFICIVM DVCTVS CHOLODOCHI  
VT ET VALVLOSAM COLLI VESICAE FELLEAE  
CONSTRVCTIONEM  
AD DISCEPTANDVM PROPONIT  
ATQVE  
SINGVLARIS VTRIVSQVE STRVCTVRAE  
EXIMIAM VTILITATEM IN VIA BILIS  
DETERMINANDA  
EXPONIT  
PRAESES  
ABRAHAMVS VATER  
PHILOSOPH. ET MED. DOCT. HVJVSQVE PROF. PVBL. ORD.  
ANATOM. ET BOTAN. SVBSTITVTVS  
RESPONDENTE  
PAVLO GOTTLOB BERGER  
ILEBVRG. MISN. MED. CVLT.  
AD D. XXII. APRILIS ANNI MDCC XX.  
WITTENBERGÆ, LITERIS GERDESIANIS,

FIG 206. Title page of volume iv of Vater's "Rissertatio Anatomica."



## EXPLANATION

Although de Graaf<sup>5a</sup> who seems to have cultivated this Sparta more accurately than others, called attention to a sign of a double pancreatic duct, and after him Winslow,<sup>6a</sup> and others, among them chiefly the great Haller,<sup>6c</sup> endowed this duct with certain characteristics; nevertheless Santorini in this Table, while he shows another transverse duct with the pancreatic duct, does not seem to have excelled his predecessors unless in inventiveness, in neatness certainly, and in zeal. For while de Graaf, to omit the others for the sake of brevity, wrote about a double duct of the pancreas (one part of which I have sometimes observed as entirely separated from the larger part, or even lacking altogether) nevertheless in his own Table 1 he certainly gives no indication of this second duct either in the drawing or in the description; on the contrary since he designated by the letter B the hindmost branch of the pancreatic duct, which corresponds to this transverse duct of Santorini, as well as the rest of the small branches of the pancreas, it is very evident that he considered this not as a special duct but as common with the other small branches. Indeed this other duct of the pancreas, since it lies almost transversely and has its slender origin in the lower parts of the wider transverse accessory ducts, enlarged by the confluence of numerous small branches, leads to that duct which lies longitudinally and enters it; however it straightway emerges from the opposite side at almost the same latitude, and running upward, enlarged on the way by the addition of branches, after a slight curve enters the duodenum about two fingerbreadths above the entrance of the longer duct. This is the route and the entrance of this duct; however, from this I do not think that the humor carried through it from below into the transverse part which flows into the second longitudinal duct, necessarily flows on into the upper part; nevertheless I consider this to be a single transverse duct, although (which is most logical) humor which indeed flows for a longer distance through the longer duct, flows partly straight, partly transversely through this smaller duct. Moreover in form, in color, in slenderness, and in humor both are entirely alike; however this is shorter and narrower; and yet sometimes its exit seems to be very wide. As I have discovered this duct very consistently, so very frequently in its longer influx or, if preferred, its efflux, I have noticed either one swollen, as de Graaf holds, or both raised up.

(k) The bile duct, or common duct, which proceeds surrounded by the cut off nature of the pancreas in its place, in which it comes into view with the end of the major pancreatic duct, equally through the major and lower caruncula designated by letter n in Table xii, terminates in the duodenum.

DD. A portion of the duodenum, which near the mouth of the pancreas, cut lengthwise, and inverted, (mm) has valvules, or wrinkles, and glandules.

## GIOVANNI DOMENICO SANTORINI

Duct of Santorini, accessory duct of pancreas, the smaller of the two ducts found in the interior of the pancreas.

Venice, Italy.

Born June 7, 1681. Died May 7, 1736.

Early education received under Jesuit priests. Classical and early medical education received from Delphini. Later studies conducted in Pisa; there studied under Malpighi and Bellini.

Doctor's degree at Pisa, October 18, 1701. Later studied in Bologna and Padua.

<sup>(a)</sup>Regneri de Graaf. Collected Works. London, 1678. Pancreatic juice Chap. 1.

<sup>(b)</sup>Treatise on the Abdomen, n. 324.

<sup>(c)</sup>Elementary Physiology, Book xxi, §vi.

1702. Became connected with Department of Anatomy in the Physico-Medical College of Venice.

1706. Became Professor of Anatomy, a position which he held until 1728.

See photostat.

Observationes Anatomicae, Venice, 1724. Opuscula Medicarum de structura et motu fibrae; nutritione animali; hemorrhoidibus; et de catamenii, 4p. 1., 228 pp. 8, Rotterdam, J. D. Beman, 1719.

Istoria d'un eto estratto felicemente intero dalle parti deretane. 51 pp. 4. Venezia, G. Tommasini, 1727.

After studying under the Jesuit priests Santorini desired to enter the priesthood much against the wishes of his father, Pietro Santorini, a pharmacist. Through the intervention of a friend of the family it was arranged that the church refuse to accept Santorini. Santorini married and had one son (Pietro) who also became a physician and upon his father's death wrote his biography (Diarium; P. Oreschi). Among Santorini's friends were Morgagni, Bernardo, Zandrini and Bonis.

Ref. Handbook Med. Sciences. Ed. 7, N.Y., Wood. 1923, 7: 635.

Biographie Universelle. Leipzig, Brockhaus, 1864. 37: 687.

Capparoni, Pietro. Profili Bio-Bibliografici di Medici E. Naturalisti celebri Italiani of the 15th to 18th century. Rome, 1925, p. 97.

Lack of space prevents the reproduction here of a photostatic copy of Vater's own description of the ampulla which bears his name and of the translation of the original Latin text. This may be found in Vater's "Qua Novum Bilis Diverticulum" (Dissertatio Anatomica t.3, p. 269).

#### ABRAHAM VATER

A dilatation at the point of junction of the pancreatic and the common bile ducts just before they enter into the duodenum.

Wittenberg, Germany.

Born 1684. Died 1757.

Vater studied medicine at the universities of Meiseburg and Leipzig and graduated at the University of Wittenberg. He then traveled extensively in Germany, England and Holland and to this latter country he returned several times to study under the most famous anatomist, Professor Ruysch.

1717. Made Professor of Medicine at the University of Wittenberg.

1719. Made Professor of Anatomy. 1737. Made Professor of Pathology at this same university.

1746. Made Professor of Therapeutics.

Qua Novum Bilis Diverticulum Circa Orificium Ductus Choledochi ut et Valvulosam Colli Vesicae Felleae Constructionem ad Disceptandum Proponit atque Singularis Utriusque Structurae Eximiam Utilitatem in via Bilis Determinanda Exponit. Paulo Gottlob Berger, Iteburg, 1720.

De Succo Nervi Secretione Mechanica. Wittenberg, 1711.

Ac Method Nova Transplantandi Variolas per Isitionem, 1710.

Catalogus Plantarum Imprimis Exoticarum Horti Adademicii Vittenburgensis, 1721.

De Chirurgiae Antiquitate ac Dignitate et Collegionem Chirurgionum Utilitate, 1724.

De Utilitate Observationis in Medicina, 1724.

De Uteru Gravidu Physiologiae et Pathologiae Considerato, 1725.

De Observationibus Rarissimis Calculorum in Corpore Humanum Generationem Illustrantibus, 1726.

De Efficacia Admiranda Chin-Chinae ad Gangraenam.

Sistendan in Anglia; De Olei Varum Efficacia Contra Morsum Canis Rabiosi Experimento Dresdae Facto Adstructa, 1736.

Museum Anatomicum Proprius Helmstadt, 1750.

**Special References**

Michaud Biographie Universelle. Paris, 1854, Vol. 42.

Grand Dictionnaire Larousse.

Reference Handbook of Medical Sciences. N. Y., Wood, 1925, Vol. 8.

**Points of Interest:**

Vater's father, Christian Vater, occupied the chair of Medicine at Wittenberg.

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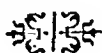
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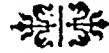
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